STRUCTURE OF MICROCARD

A01/1 = Structure of microcard

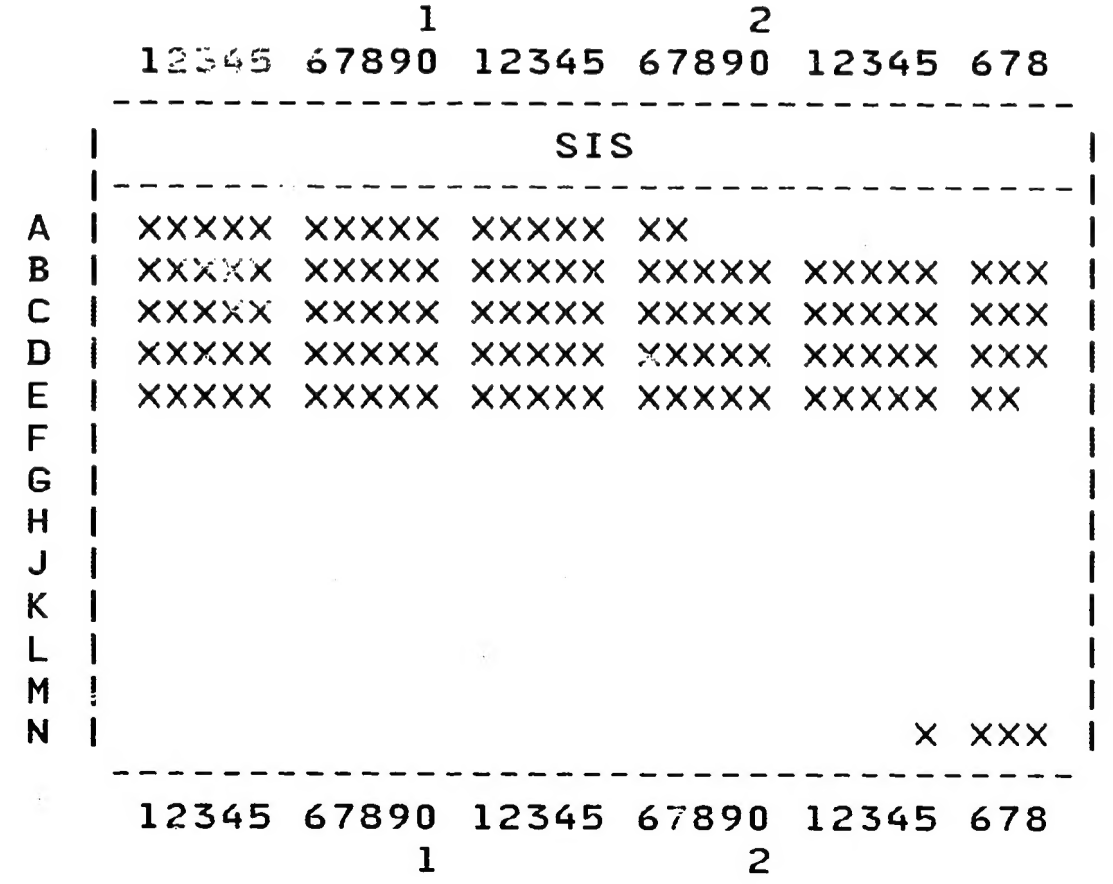
A03/1 = Special features, general, testers and tools, test specifications, tightening torques

B01/1 = Testing

N27/1 = Table of contents

N28/1 = Editorial note

Continue: A02/1 Fig.: A01/2



Continue: A02/1

STRUCTURE OF MICROCARD

The user prompting appears on every page, e.g.:

- Continue: B17/1
- Continue: B18/1 Fig.: B17/2
- Yes: B18/1 No: B15/1
- Yes: B17/1 No: B16/1 Fig.: B15/2

.../1 = upper coordinate half
.../2 = lower coordinate half

Continue: A01/1

SPECIAL FEATURES

These instructions describe testing and adjustment of the fuel-injection pumps

PE(S)..H.. (control-lever pump)

in conjunction with the appropriate governor positioners

RE 33 and RE 36.

Repair of these assemblies is described in separate instructions - refer to table of contents.

Continue: A03/2

SPECIAL FEATURES

The control-lever pump - the "H" in the type designation stands for plunger-and-barrel assemblies with control lever - is a new development. In conjunction with the flange-mounted governor positioner this series is the main component of the EDC system (Electronic Diesel Control) for regulating injected quantity and start of delivery.
The control-lever pump is available in two sizes:
RP 39, design code as of ..S 1,
plunger stroke 18 mm,
positioner RE 33
RP 43, design code as of ..S 1000,
plunger stroke 14 mm,
positioner RE 36

Continue: A04/1

SPECIAL FEATURES

Further special features of control-lever pump:

Depending on version, fuel inlet and return via EHAB (electro-hydraulic shut-off device) or via ELAB (electric shut-off device).

Both versions are part of the EDC safety system and perform an important function as redundant shut-off device.

Continue: A04/2

SPECIAL FEATURES

Function of EHAB:

The EHAB is a solenoid-controlled switching valve which operates in conjunction with the fuel supply pump.

In operating position (as of engine start) current is applied to the solenoid valve (actuation by EDC control unit) which is switched in such a manner that the pump suction gallery is filled via a supply pump, filter and EHAB.

Continue: A05/1

SPECIAL FEATURES

Function of EHAB:

On shutting off the engine (EHAB deenergized) the solenoid valve reverses the direction of fuel flow. The supply pump then draws fuel off from the pump suction gallery, filling of the plunger-and-barrel assemblies is rapidly interrupted and the engine shut off.
The EDC safety system triggers this function in the event of a serious fault (e.g. control rod sticking) so as to shut off the engine immediately.

Continue: A05/2

SPECIAL FEATURES

Function of ELAB:

The ELAB is also a solenoid-controlled switching valve in the inlet to the pump suction gallery. In operating position (as of engine start) current is likewise applied to this valve (actuation by EDC control unit) which opens up the inlet to the suction gallery.
If shut-off is effected by the EDC safety system, the valve is reversed and connects the fuel inlet directly to the return. Filling of the plunger-and-barrel assemblies is thus interrupted and the engine shut off.

Continue: A06/1

GENERAL

There are no differences between pump sizes RP 39 and RP 43 in terms of design and mode of operation. The procedure is likewise the same when testing/adjusting pump and RE positioner.

Special reference is made to the need to use the correct test equipment for the respective pump and positioner design in line with the information given in these instructions and the corresponding test-specification sheet.

Continue: A06/2

GENERAL

These instructions describe two approaches, i.e. to all intents and purposes there are two different sets of instructions:

1. TEST AND ADJUSTMENT INSTRUCTIONS
   As of Coordinate: B01/1
   Proceed as per these instructions if any work, e.g. repair work, has to be performed on the injection-pump assembly to be tested/adjusted. The sequence of operations in these instructions is always to be observed.

Continue: A07/1

2. CHECKING INSTRUCTIONS

As of Coordinate: F01/1

Proceed as per these instructions if an injection-pump assembly is to be tested in its as-received condition without any work being performed on it beforehand (e.g. warranty test). Some of the operations given in these instructions are taken from the test and adjustment instructions, however the order is different. Here again, the sequence must be observed.

Continue: A07/2

SPECIAL VERSIONS:

A separate section of these instructions deals with manufacturer-specific special features.
This involves the disassembly and assembly of manufacturer-specific drive flanges and the special procedure for the start-of-delivery mark (Mercedes-Benz) and start-of-delivery blocking (Scania) (status at time of printing of these instructions).
Attention must be paid to this section.
As of Coordinate: H01/1

Continue: A08/1

SAFETY MEASURES

Skin protection: To avoid irritation when handling calibrating oil, lubricants and greases, apply hand cream before starting work and wash with soap and water afterwards.

Continue: A08/2

SAFETY MEASURES

Safety regulations to be observed when handling combustible liquids:

* In Germany:
  Order Governing Work With Combustible Liquids (VBF) as issued by Federal Ministry of Labor (BmA).
  Safety regulations for handling chlorinated hydrocarbons:
  - in companies: ZH 1/222
  - for employees: ZH 1/129
  as issued by the Main Association of Commercial Liability Insurance Associations (Central Association for Accident Prevention and Industrial Medicine), Langwardweg 103, 55129 Bonn.

Continue: A09/1

SAFETY MEASURES

Safety regulations when handling flammable liquids (continued):

* In all other countries:

  In all other countries the local regulations are to be observed.

Continue: A09/2

SAFETY MEASURES

For testing/adjusting injection pump and RE positioner exclusive use is to be made of the special tools and testers listed and illustrated in these instructions.

The use of incorrect/unsuitable tools and testers can lead to the danger of injury as well as possible product and component damage.

Furthermore, precise/correct adjustment is only possible when using the appropriate tools and fixtures.

Continue: N27/1

TESTERS, FIXTURES AND TOOLS

The following list indicates all the testers and tools - both new and existing tools (for other pump versions) - required for testing and adjusting control-lever pumps with RE positioner.

In the case of existing parts previously ordered using the type designation, the designation is indicated in brackets.

Commercially available tools are not listed.

Continue: A10/2

TESTERS, FIXTURES AND TOOLS

The version-specific test equipment such as calibrating nozzle holder, test lines and overflow valve, is to be taken from the respective test-specification sheet.

Note: The following list only covers pump versions released when these instructions were printed.

Continue: A11/1

TESTERS, FIXTURES AND TOOLS

Drive:

Injection-pump drive for complying with torsion limits stipulated in ISO 4008/1 (test bench end) with:

* Drive coupling	1	686 401 024
in conjunction with		
* intermediate flange	1	685 700 140
* and protective cover	1	685 510 022

Continue: A11/2

TESTERS, FIXTURES AND TOOLS

Drive:

Drive flange, pump end:

* RP 39, taper 40mm short	1	685 702 075
taper 40mm long	1	685 702 076
* RP 43, taper 35mm short	1	685 702 073
taper 35mm long	1	685 702 074
* Plus hook wrench	1	687 950 530

Continue: A12/1

TESTERS, FIXTURES AND TOOLS

For clamping injection pump:

	RP 39	RP 43
Flange mounting:		
* Clamping bracket for		
- center clamping:		
1 688 010 124	+	+
- external clamping:		
1 688 010 129	+	+
* Clamping flange 107 mm:		
1 685 720 159		+
* Clamping support:		
1 688 030 141		+

Continue: A12/2

TESTERS, FIXTURES AND TOOLS

Flange mounting (continued):

	RP 39	RP 43
* Clamping flange 115 mm:		
1 685 720 239	+	
* Clamping support:		
1 688 030 184	+	

Clamping flange ..239 and clamping support ..184 are combined together with various fastening parts as parts set for all RP 39 flange pumps. Part no. 1 687 001 314, short designation EPS 917.

Continue: A13/1

TESTERS, FIXTURES AND TOOLS

Flat-bed mounting:

	RP 39	RP 43
* Clamping support (2 x required):		
- 1 688 030 141		+
- 1 688 030 170	+	

Cradle mounting:

* Clamping support (2 x required):	
- 1 688 030 153	+

Continue: A13/2

TESTERS, DEVICES AND TOOLS

* Test control unit (universal evaluation circuit) for testing and adjusting rack position sensor	0 986 610 101 KDEP-P 400/1
* Universal test lead (connection of test control unit in conjunction with following version-specific adapter leads)	0 986 610 102 KDEP-P 400/2

Continue: A14/1

TESTERS, FIXTURES AND TOOLS

* Adapter leads for version-specific positioner connection:	
- Housing-fixed round screw connection	0 986 610 104 KDEP-P 400/3
- Cable outlet with overhung Schlemmer plug (MAN)	0 986 610 107 KDEP-P 400/6
- Cable outlet with Deutsch plugs (Scania as of 1995)	0 986 610 114

Continue: A14/2

TESTERS, FIXTURES AND TOOLS

* Regulator 12 V/15 A (adjustable current output) for actuation of adjusting magnet	comm. avail.
* Regulator 12 V/3 A for power supply, test control unit and EHAB/ELAB	comm. avail.
* Voltmeter (digital multimeter) Requirements: Basic accuracy DC: - less than 0.1 % of reading - resolution 0.001 V in range up to approx. 4 V	comm. avail.

Continue: A15/1

TESTERS, FIXTURES AND TOOLS

* Start-of-delivery blocking device for positioning start-of-delivery disk cam	0 986 611 746 KDEP 1077
* CRT measuring device	1 688 130 130
* Accessory set for P-pumps for 1 688 130 130	1 687 000 053
* Threaded sleeve (female thread) for attaching CRT measuring device (special accessory for 1 688 130 130)	1 683 315 022

Continue: A15/2

TESTERS, FIXTURES AND TOOLS

* Adjustment gauge for adjusting and testing - Prestroke shaft - RPS short-circuiting ring	0 986 612 620
* Prestroke measuring device	1 688 130 112
Driver pin for:	
- RP 39 (82.5 mm):	1 682 012 015
- RP 43 (79.5 mm):	1 682 012 004
Screw-in sleeve (56.4 mm):	1 683 350 032

Continue: A16/1

TESTERS, FIXTURES AND TOOLS

* Travel measuring device for prestroke solenoid	0 986 612 657
* Mounting cover for travel measuring device	0 986 612 676
* Dial-indicator holder for travel measuring device	1 688 130 030
* Dial indicator Range 30 mm, graduations 0.01 mm, for - prestroke measuring device - travel measuring device (prestroke solenoid)	1 687 233 012

Continue: A16/2

TESTERS, FIXTURES AND TOOLS

* Feeler for dial indicator - Diameter 3 mm - Length approx. 80 mm - Thread M 3	comm. avail. or user manufacture
* Adapter for connecting calibrating oil inlet and return to suction gallery	0 986 612 653

Continue: A17/1

TESTERS, FIXTURES AND TOOLS

* Guide pin (set = 2 x) for mounting RE positioner on injection pump	0 986 612 598
* Pin-type socket wrench for removing RPS plastic seal	0 986 611 459 KDEP 2990
* Disassembly tool for wedge screw of prestroke-shaft adjusting lever	0 986 612 640

Continue: A17/2

TESTERS, FIXTURES AND TOOLS

* Assembly wrench (pin-type socket wrench) for screwing out and screwing in retaining ring - prestroke shaft bearing	0 986 612 643
* Assembly sleeve for protecting seal ring in prestroke shaft bearing	0 986 612 639
* Box wrench for adjusting delivery	0 986 611 452 KDEP 2997

Continue: A18/1

TESTERS, FIXTURES AND TOOLS

* Vacuum gauge for testing oil pump in RE positioner	comm. avail. or Bosch: 1 688 130 032
* Hose (2 x required) for EHAB testing	1 680 711 002

Continue: A18/2

TESTERS, FIXTURES AND TOOLS

* Clamping flange For clamping pump to test bench on disassembly/ assembly of drive flange (Mercedes Benz, MAN)	1 685 720 210
* Holding device for disassembly/assembly of drive flange	0 986 612 694
* Setting pin for start-of-delivery blocking (Scania)	0 986 612 697

Continue: N27/1

TEST SPECIFICATIONS

For each injection-pump assembly (control-lever pump with RE positioner) there is a test-specification sheet which is to be established according to assembly number and table of contents.
This sheet contains all the necessary test specifications and settings.

These test instructions therefore only feature general values applicable to all versions.

Continue: A20/1

TEST SPECIFICATIONS

General test specifications:

Resistance measurements at positioner:

Positioner with housing-fixed round plug-in connection, pin:

1-6 (RPS coil 1)	17...23 Ohm
6-5 (RPS coil 2)	17...23 Ohm
1-5 (RPS total)	34...46 Ohm
2-7 (Adj. magnet, qty.)	0.55...0.90 Ohm
3-4 (Prestroke solenoid)	1.10...1.55 Ohm

Continue: A20/2

TEST SPECIFICATIONS

General test specifications:

Positioner with cable bushing and overhung Schlemmer plug:

Resistance measurements at plug, pin:

1-6 (RPS coil 1)	17...23 Ohm
5-6 (RPS coil 2)	17...23 Ohm
1-5 (RPS total)	34...46 Ohm
7-8 (Adj. magnet, qty.)	0.55...0.90 Ohm
3-4 (Prestroke solenoid)	1.10...1.55 Ohm

2 - not used

Continue: A21/1

TEST SPECIFICATIONS

General test specifications:

Fuel temperature sensor
(if fitted)
Resistance value at calibrating-oil
temperature:
38...42 Grad C: 950...1400 Ohm

Axial clearance, prestroke
shaft: 0.10...0.15 mm

Continue: A21/1

TEST SPECIFICATIONS

General test specifications:

ELAB internal resistance:
12 V: 9.8...11.4 Ohm
24 V: 42.0...48.0 Ohm

ELAB functional test:
* Speed: 1000 1/min
* Actual voltage (U/act): 3.100 V
* Measurement time following
ELAB current cutout: 10 sec.
* Delivery after
measurement time: zero

Continue: A22/1

TEST SPECIFICATIONS

General test specifications:

EHAB internal resistance:

12 V:	9.5...12 Ohm
24 V:	36 ...46 Ohm

EHAB functional test:

* Speed:	1000 1/min
* Actual voltage (U/act):	3.100 V
* Measurement time following ELAB current cutout:	1 sec.
* Delivery after measurement time:	zero

Continue: A22/2

TEST SPECIFICATIONS

General test specifications:

Oil-pump functional test:

* Oil fill:	as far as overflow, however max. 100 cm3
* Speed:	1000 1/min
* Actual voltage (U/act): (control rod in shutoff position)	0...1 V
* Measurement time:	30 sec.
* Desired vacuum:	> 25 mbar

Continue: N27/1

ADHESIVES AND LUBRICANTS,
MATERIAL DESIGNATION

The list only contains those materials required for finishing and testing of the IP assembly.

* Locking compound for micro-encapsulated screws after thread cleaning	Loctite 242 (blue, red bottle)
* Lubricating oil HD 30 for first fill, pump and positioner	comm. avail.

Continue: A23/2

ADHESIVES AND LUBRICANTS,
MATERIAL DESIGNATION

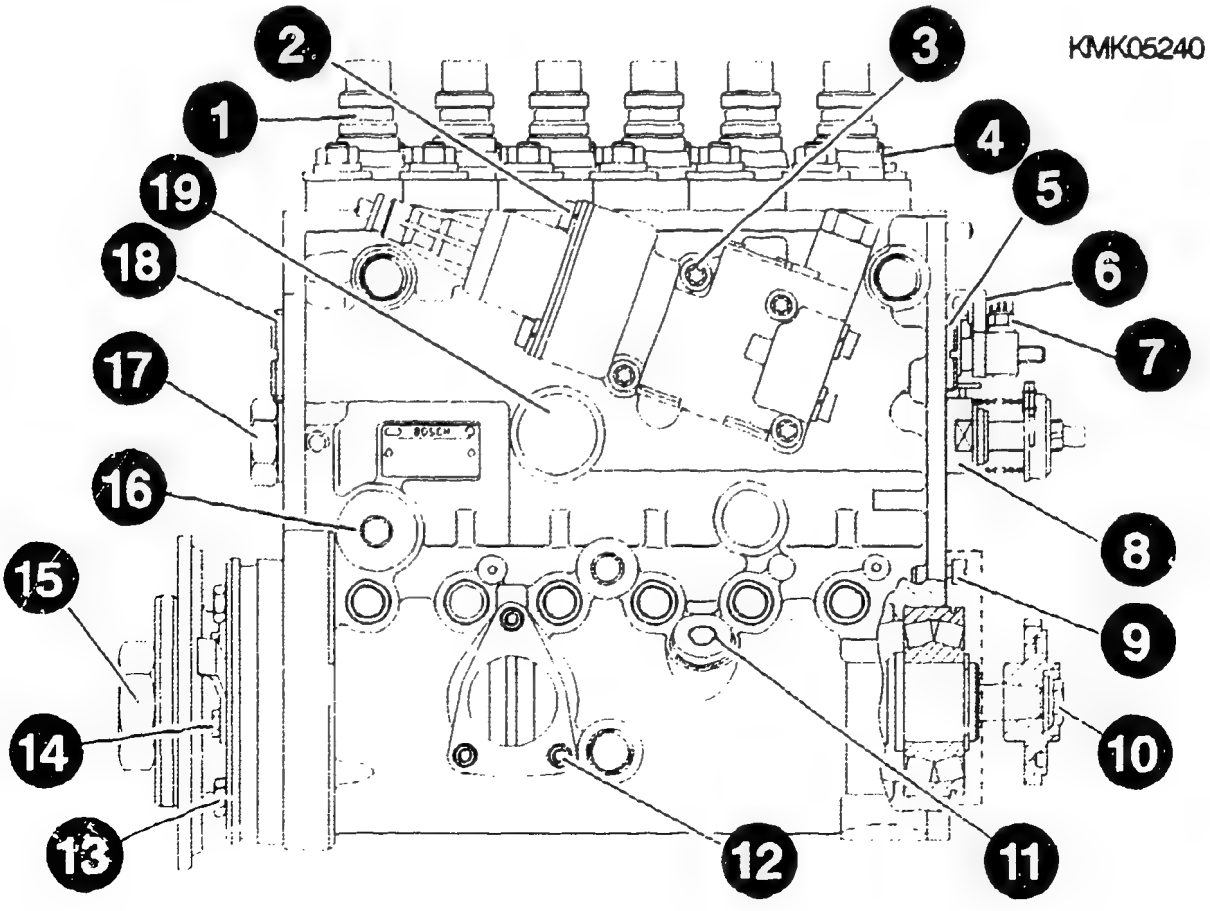
* Molycote oil for adding to lubricating-oil first fill (10 % additive)	comm. avail. e.g. Molycote W 15)
* Tallow for seal rings	comm. avail.
* Tallow/oil mixture Assembly aid	5 963 340 005

Continue: N27/1

TIGHTENING TORQUES

1 =	Delivery-valve holder, assembly diameter 11, 12 mm:	110...120	Nm
2 =	Fastening screws, EHAB solenoid (2):	7...9	Nm
3 =	Fastening screws, EHAB/ELAB:	7...9	Nm
4 =	Fastening nuts, barrel-and-flange elements:	50...55	Nm
5 =	Threaded sleeve, prestroke shaft bearing:	30...40	Nm
6 =	Prestroke control-lever correction screw:	5...7	Nm
7 =	Prestroke control-lever wedge screw:	6...7	Nm

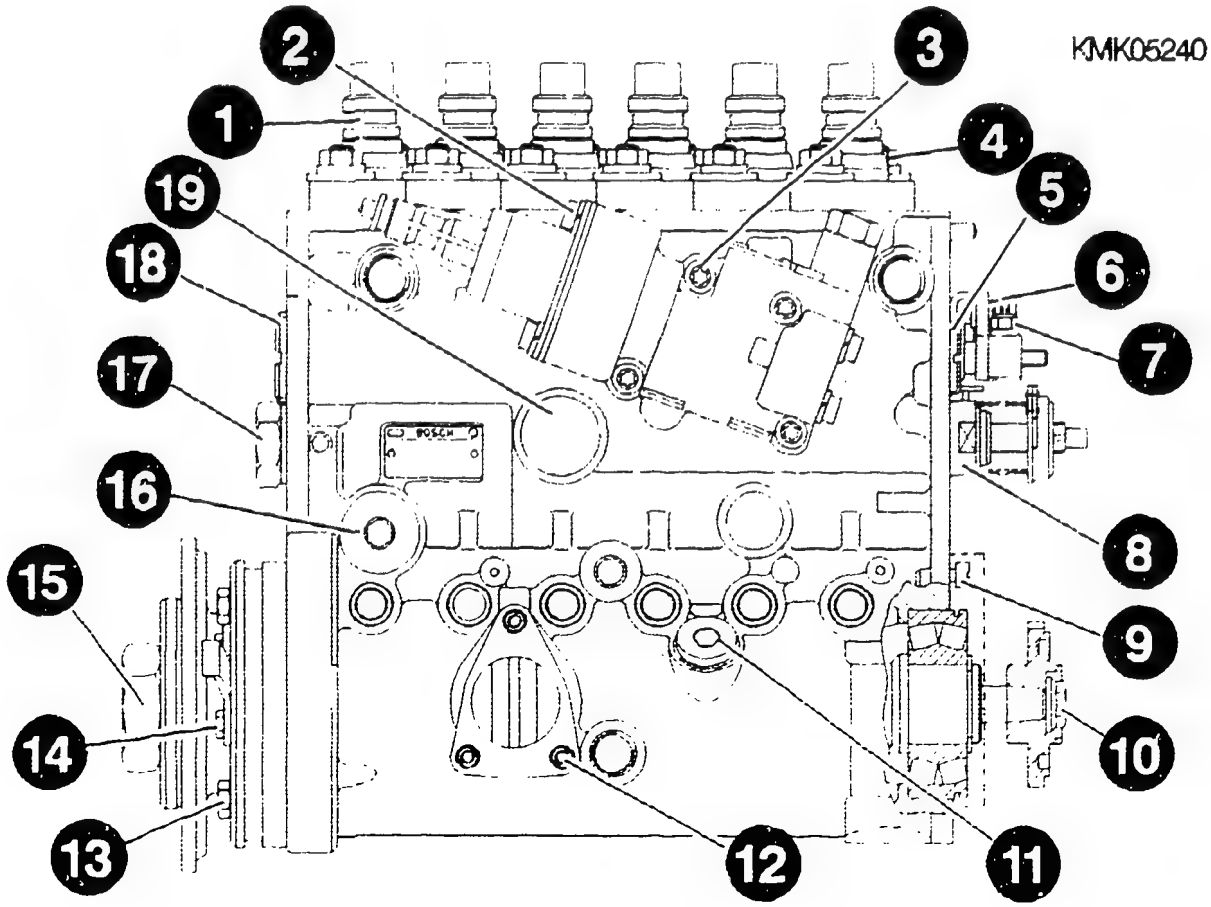
Continue: A25/1 Fig.: A24/2



TIGHTENING TORQUES

8 =	Bushing - quantity control rod:	30...40	Nm
9 =	Fastening screws, bearing flange:	7...9	Nm
10 =	Fastening nut, disk cam:	90...100	Nm
11 =	Oil check screw:	30...40	Nm
12 =	Supply pump		
	- stay bolts:	3.5...4.5	Nm
	- nuts:	7...9	Nm
13 =	Fastening screws, drive-end shield (M 8):	18...20	Nm
14 =	Fastening screws, start-of-delivery marking plate:	7...9	Nm

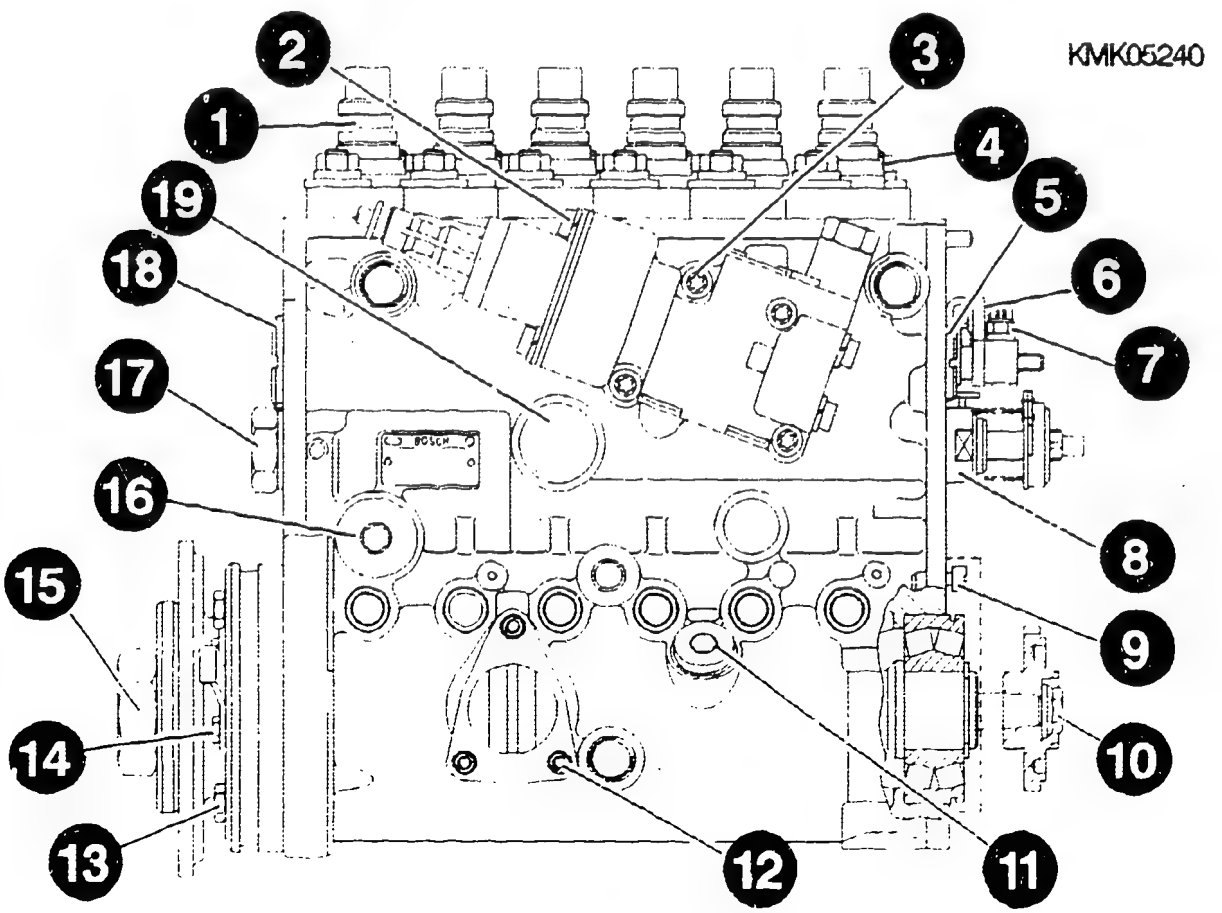
Continue: A26/1 Fig.: A25/2



TIGHTENING TORQUES

15 =	Hexagon nut, drive coupling: Differs from manufacturer to manufacturer, see section "SPECIAL VERSIONS" Coordinate	H01/1	
16 =	Screw plug, pre-stroke bore:	40...60	Nm
17 =	Cap nut, control-rod guide:	40...60	Nm
18 =	Threaded sleeve, pre-stroke shaft bearing:	30...40	Nm
19 =	Fuel temperature sensor:	30...35	Nm

Continue: A27/1 Fig.: A26/2

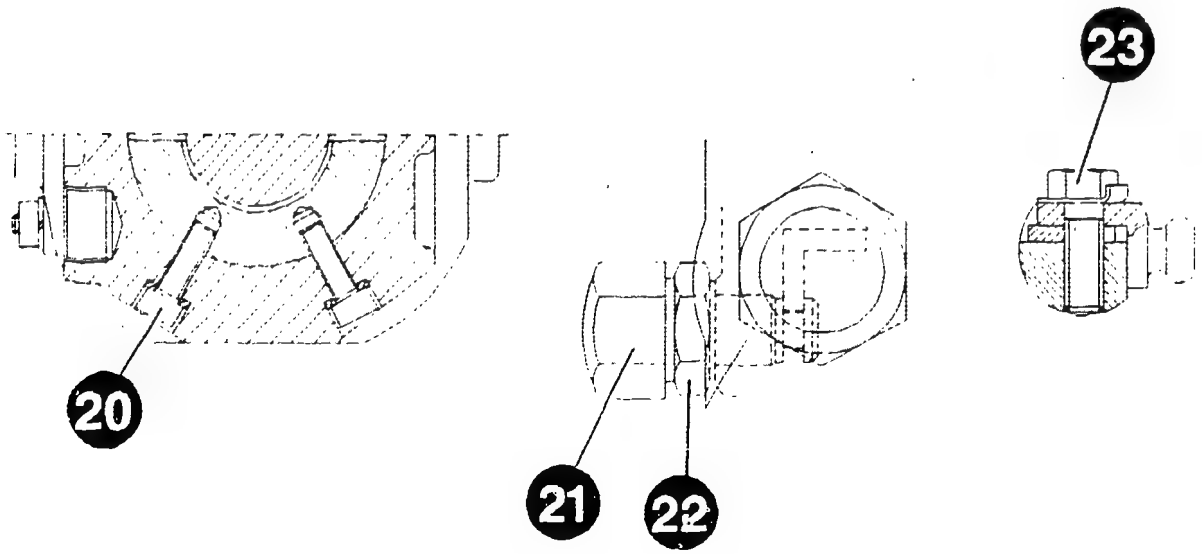


TIGHTENING TORQUES

20 =	Fastening screws, camshaft intermediate bearing:	
	- Aluminum:	7...9 Nm
	- Bronze/steel:	8...10 Nm
21 =	Cap nut, control-rod guide:	12...15 Nm
22 =	Lock nut, control-rod guide:	15...18 Nm
23 =	Fastening screw, pre-stroke shaft driver	5.5...6 Nm

Continue: N27/1 Fig.: A27/2

KMK05241



TEST AND ADJUSTMENT INSTRUCTIONS

Table of contents:

Continue: B01/2

TEST AND ADJUSTMENT INSTRUCTIONS

Table of contents (continued):

Continue: B02/1

Table of contents (continued):

Continue: B02/2

TEST AND ADJUSTMENT INSTRUCTIONS

Table of contents (continued):

Continue: B03/1

TEST AND ADJUSTMENT INSTRUCTIONS

These instructions give a detailed description of all operations for testing and adjustment of control-lever injection pumps with RE positioner on which work, e.g. repair work, has previously been performed. These instructions contain numerous similarities with test steps for familiar assemblies, such as P-pumps with RE positioner. It is however important to comply with the specified procedure and to keep to the sequence of operations indicated. It is imperative that use be made of the stated tools and testers and that their specifications be observed.

Continue: B03/2

TEST AND ADJUSTMENT INSTRUCTIONS

Starting point for these instructions:
Injection pump ready-assembled.
RE positioner not fitted.
Prestroke control lever mounted on prestroke shaft, stop strap not fitted.
Oil pump (viscous pump) not fitted.
EHAB/ELAB and supply pump also not fitted.
As regards adjustment of assembly, it is assumed that RE positioner has been tested and repaired if necessary (refer to repair instructions).

Continue: B04/1

TEST AND ADJUSTMENT INSTRUCTIONS

Special instructions for testing/ adjusting prestroke/start of delivery:

The procedure for basic setting as described in the following is always to be maintained and performed in its entirety if work has been carried out on the assembly.

Initial checking of an assembly (without work previously having been performed) is governed by the procedure indicated in the CHECKING INSTRUCTIONS.

See Coordinate: F01/1

Continue: B04/2

TEST AND ADJUSTMENT INSTRUCTIONS

Special instructions for testing/ adjusting injected quantity:

A basic prerequisite for correct injected-quantity setting is proper and precise adjustment of the RPS and these isntructions are thus structured accordingly.

Initial checking of an assembly (without prior performance of work) is likewise governed by the CHECKING INSTRUCTIONS.

See Coordinate: F01/1

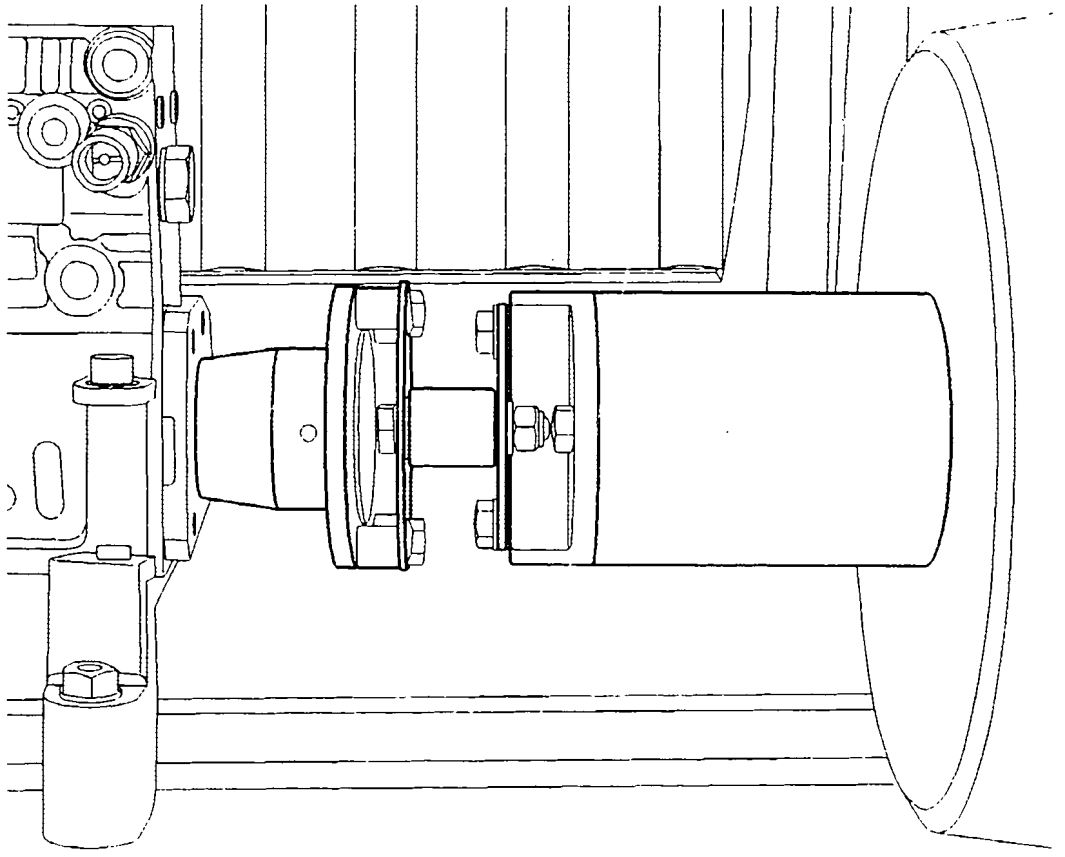
Continue: B05/1

Installing injection pump on test bench:

Drive coupling, test-bench end:
To comply with the torsion limits stipulated in ISO 4008/1 the test bench must be equipped with the heavy-duty drive coupling 1 686 401 024, in conjunction with intermediate flange 1 685 700 140 and protective cover 1 685 510 022. Installation is to be performed in accordance with the detailed operating instructions enclosed with the coupling. The illustration shows the completely assembled coupling with the additional protective cover which has to be used in operation having been removed for reasons of clarity.

Continue: B06/1 Fig.: B05/2

KMK05576



Installing injection pump on test bench:

Ensure compliance with prescribed tightening torques when installing drive coupling and intermediate flange:

Fastening screws for:
* Interm. flange at inertia flywheel:
  M 12 = 92...98 Nm
  M 10 = 52...58 Nm
* Coupling at intermed. flange:
  92...98 Nm

Slip protective cover onto original guard and secure.

Continue: B07/1

TEST AND ADJUSTMENT INSTRUCTIONS

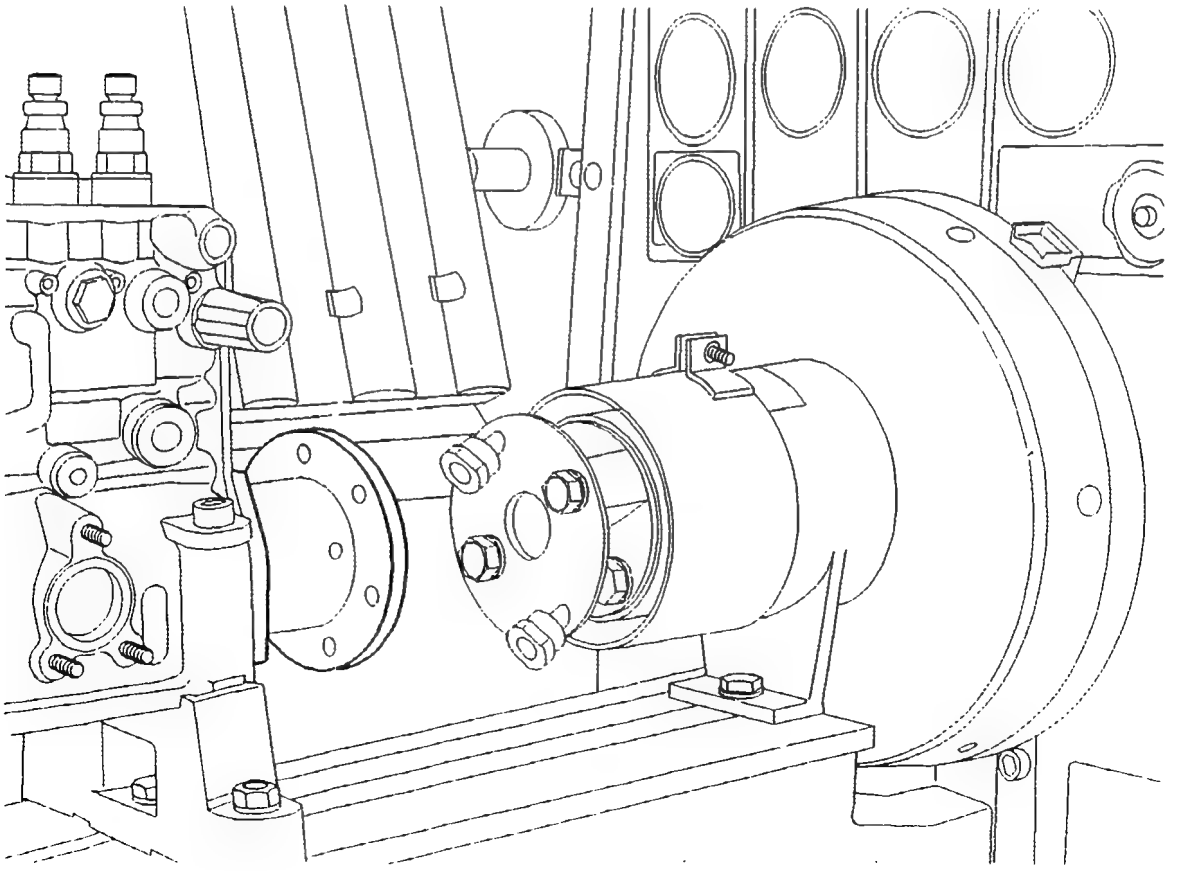
Installing injection pump on test bench:

Establishment of the pump-end drive flange is determined by the camshaft taper:

RP 39, taper 40 mm short: 1 685 702 075
taper 40 mm long: 1 685 702 076
RP 43, taper 35 mm short: 1 685 702 073
taper 35 mm long: 1 685 702 074
For counter-holding at drive flange:
Hook wrench 1 687 950 530

Continue: B08/1 Fig.: B07/2

KMK05577



TEST AND ADJUSTMENT INSTRUCTIONS

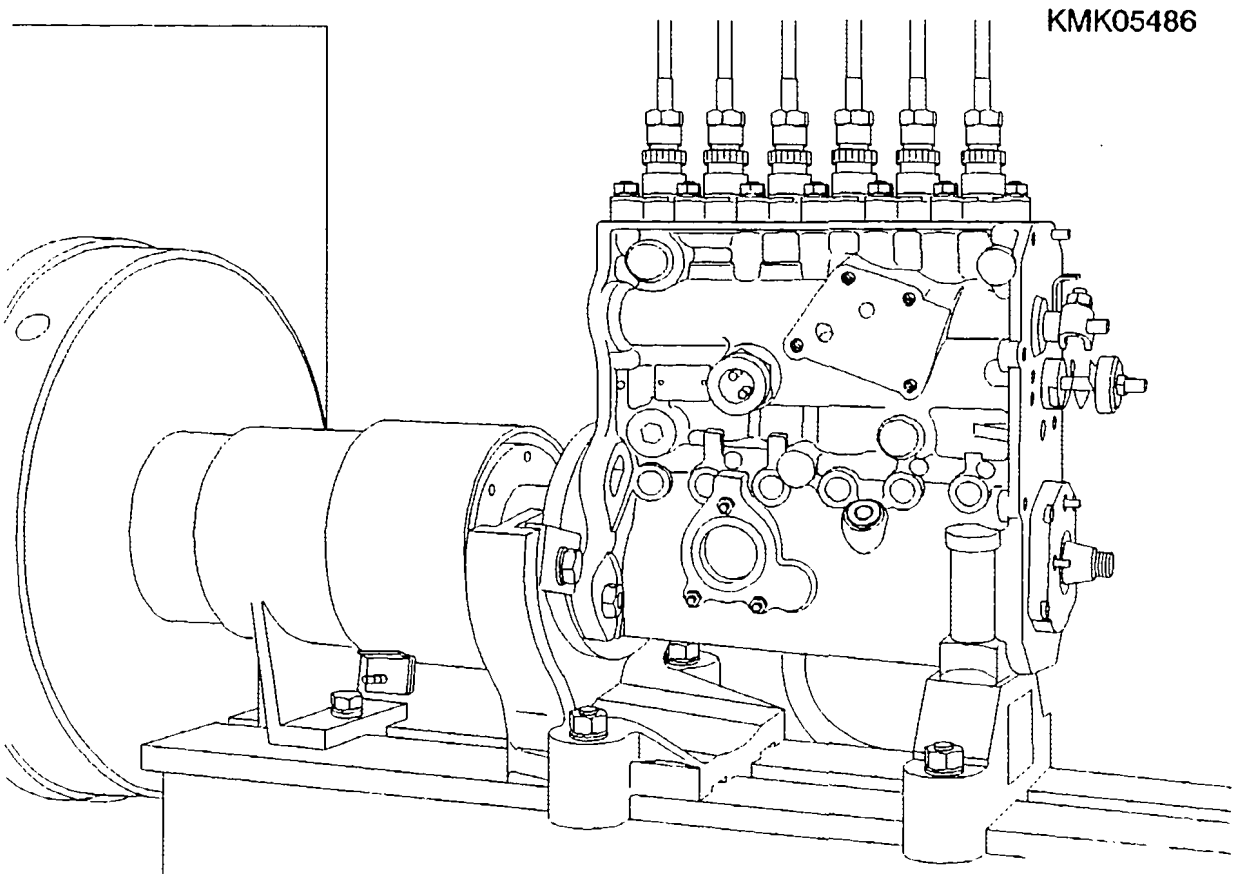
Installing injection pump on test bench:

Install injection pump on clamping supports for appropriate version (flange, cradle, flat bed mounting).

For exact specification of clamping parts refer to tool list
Coordinate: A10/1

Slightly lubricate clamping bed of test bench so that clamping supports are easy to move with pump clamped in position.

Continue: B09/1 Fig.: B08/2



TEST AND ADJUSTMENT INSTRUCTIONS

Installing injection pump on test bench:

Note: Make sure that pump is attached to camshaft without axial tension.

Push pump against drive coupling and connect with 2 fastening screws.
Tightening torque: 33...37 Nm.
Secure clamping supports with clamping screws such that they are easy to move.

Continue: B09/2

TEST AND ADJUSTMENT INSTRUCTIONS

Installing injection pump on test bench:

Slowly (max. 30 l/min.) turn test bench drive so that camshaft of pump assumes normal position with no axial tension. Then secure clamping supports in position on clamping bed.

Set and secure guard with protective cover such that drive-coupling hazard zone is covered.

Continue: B10/1

TEST AND ADJUSTMENT INSTRUCTIONS

Installing injection pump on test bench:

Determine other test equipment - calibrating nozzle holder, test pressure lines, overflow valve - in line with information given in test-specification sheet for respective pump version.

Note: The respective test equipment and test conditions must be adhered to as otherwise incorrect adjustment will result.

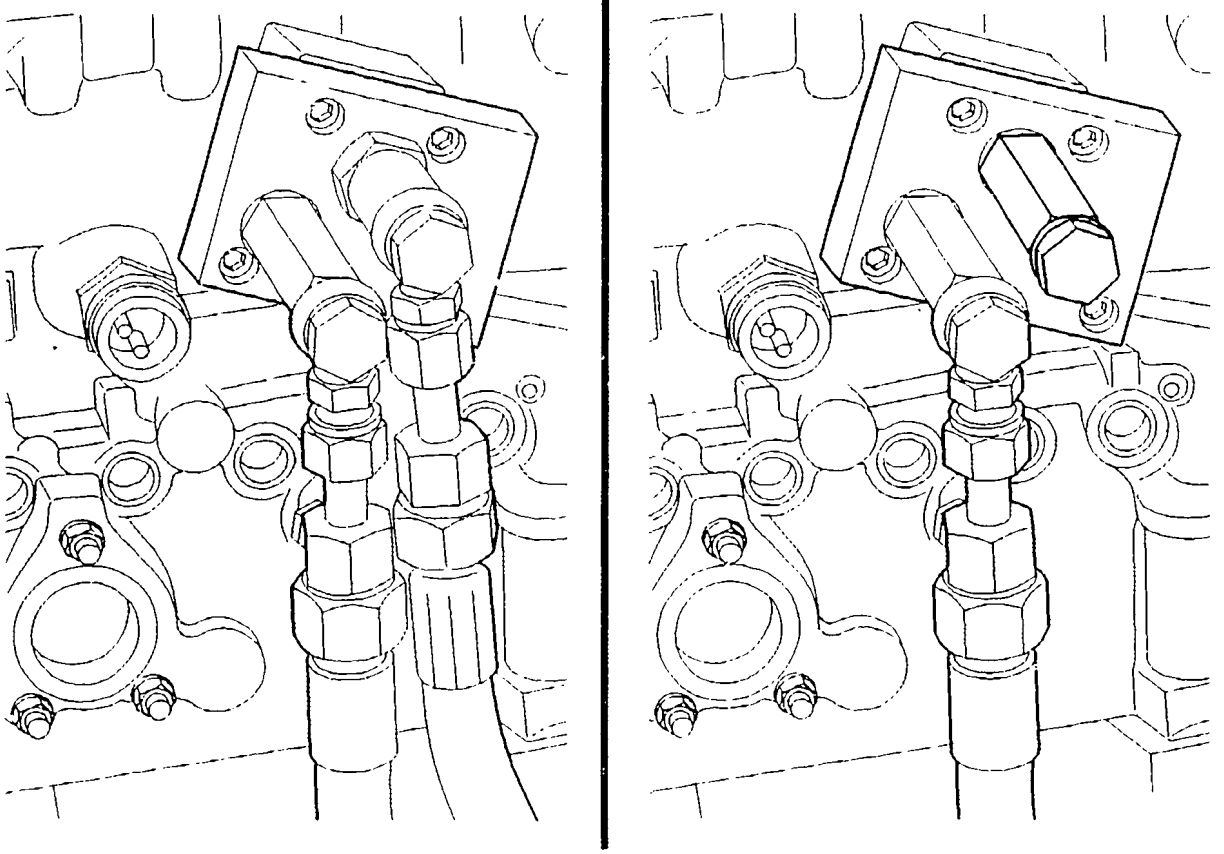
Continue: B11/1

Calibrating-oil connections:

Use the four screws supplied to screw the adapter 0 986 612 653 instead of the EHAB/ELAB to the flange such that inlet and return bores coincide.
O-ring end = flange end.
For scavenging/warm-up of pump and delivery tests: calibrating-oil inlet at lower connection, overflow valve and return at upper connection (left).
The upper connection (right) is sealed for testing start of delivery.

Continue: B12/1 Fig.: B11/2

KMK05578



TEST AND ADJUSTMENT INSTRUCTIONS

Lubricating-oil first fill:

First fill of camshaft chamber with lubricating oil HD 30 with addition of 10 % Molycote oil W 15 (Molycote - trade name).
Quantities in milliliters:

	5-,6-barrel	8-barrel
RP 39	400	500
RP 43	350	450

Seal supply-pump opening and overflow bores in drive flange on flange pumps with suitable plug.

Continue: B13/1

TEST AND ADJUSTMENT INSTRUCTIONS

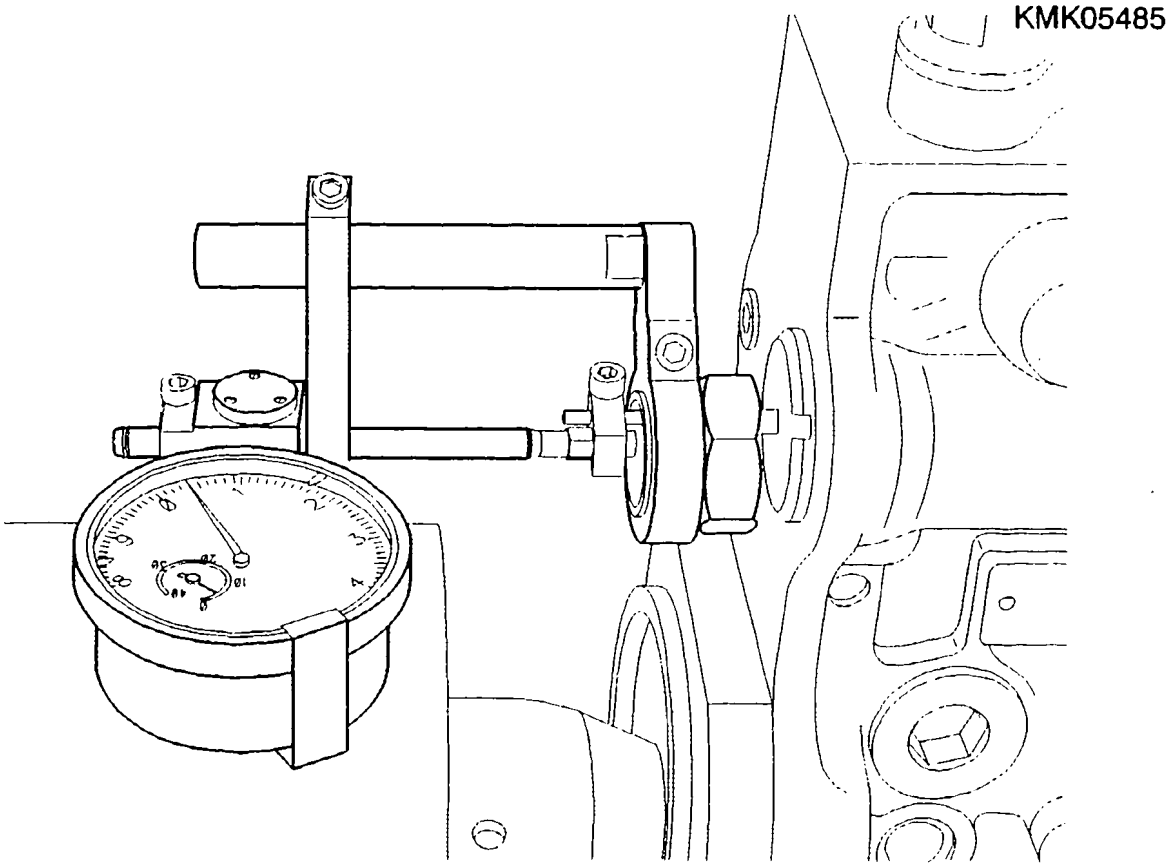
Attaching CRT measuring device:

CRT measuring device:	1 688 130 130
Accessory set for P-pump:	1 687 000 053
Threaded sleeve:	1 683 315 022

Unscrew cap nut of control rod on pump drive end. Screw on threaded sleeve and attach CRT measuring device to threaded sleeve.

Screw coupling pin into control rod, screw threaded clamping piece into dial indicator and secure at coupling pin.

Continue: B14/1 Fig.: B13/2



TEST AND ADJUSTMENT INSTRUCTIONS

Presetting CRT measuring device:

Press control rod by hand as far as start-position stop and set dial indicator to exactly 21 mm CRT.

Continue: B15/1

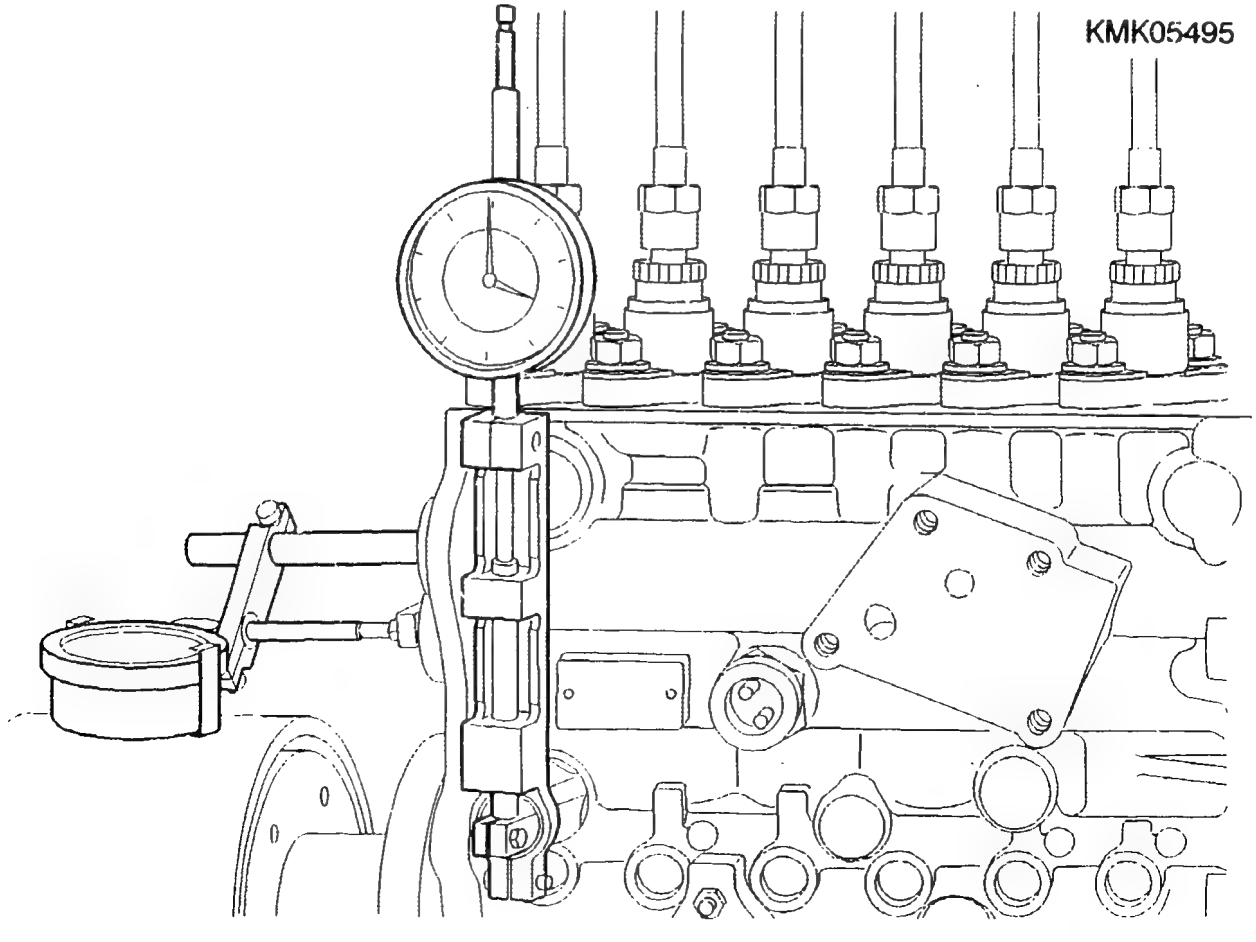
TEST AND ADJUSTMENT INSTRUCTIONS

Attaching prestroke measuring device:

Prestroke measuring device:	1 688 130 112
Driver pin for:	
- RP 39 (82.5 mm):	1 682 012 015
- RP 43 (79.5 mm):	1 682 012 004
Screw-in sleeve (56.4 mm):	1 683 350 032
Dial indicator	1 687 233 012

Screw out screw plug at start-of-delivery adjustment barrel and screw in threaded sleeve of measuring device. Pay attention to important usage information on next Coordinate.

Continue: B16/1 Fig.: B15/2



Important note on use of prestroke measuring device:

Only slip measuring device onto threaded sleeve as far as stop in BDC position of roller tappet.
Do not exceed prestroke measuring range with measuring device fitted.
When measuring device is in position roller tappet must not execute full stroke as otherwise driver pin will be sheared off.

Continue: B17/1

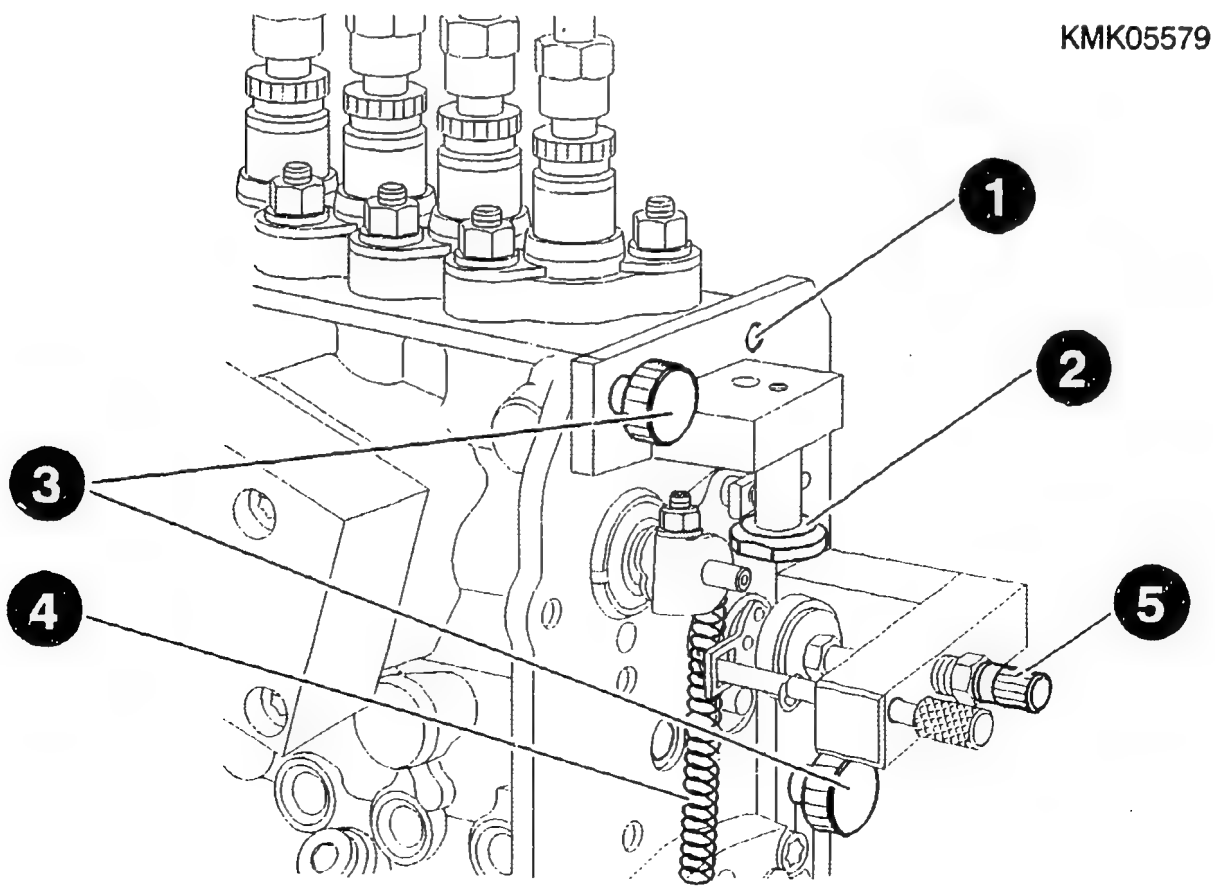
TEST AND ADJUSTMENT INSTRUCTIONS

Prestroke shaft - basic setting:

Position adjustment gauge 0 986 612 620 at pump - governor end - (positioning pin mount, 1) such that driver (propeller) of prestroke control lever makes contact with round support of device (2). Screw on gauge with knurled screws (3).

Position propeller support (e.g. with spring, 4).

Continue: B18/1 Fig.: B17/2

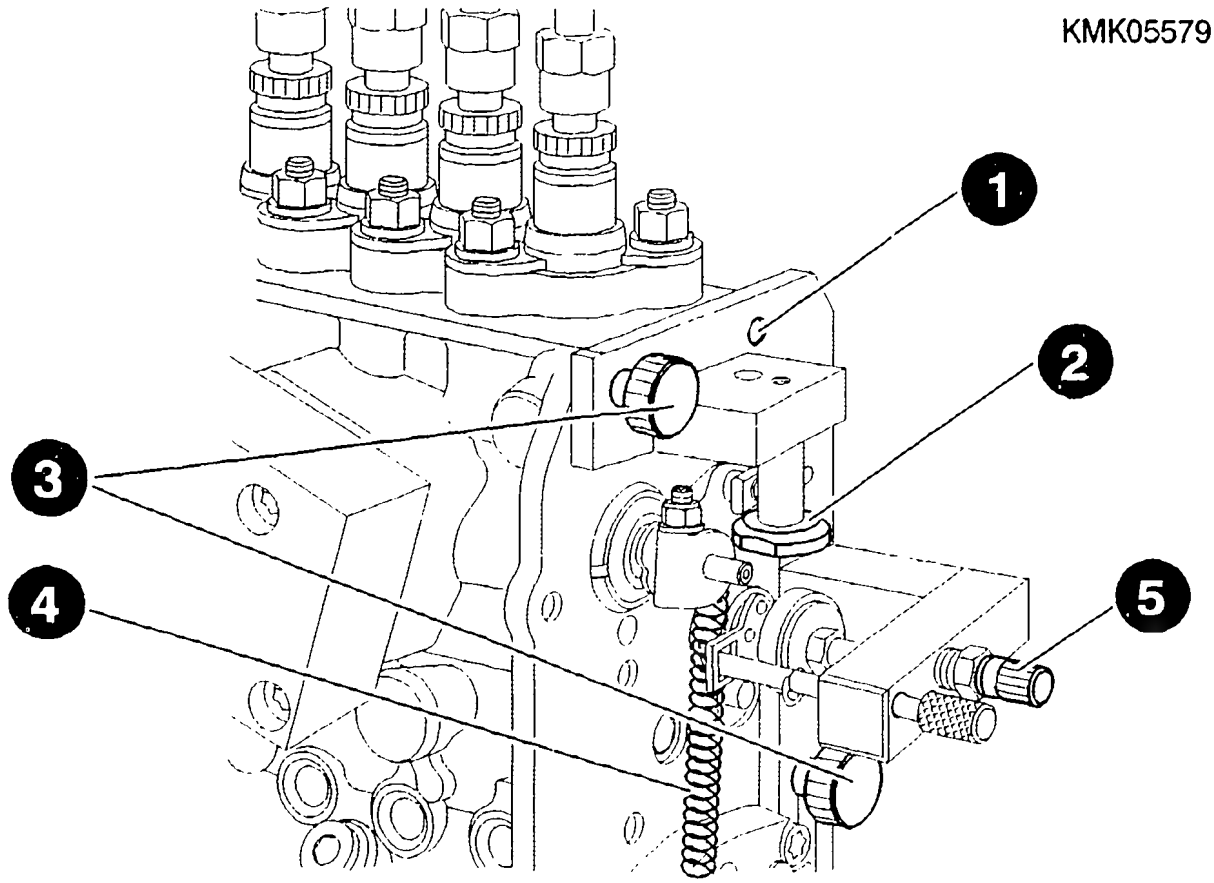


TEST AND ADJUSTMENT INSTRUCTIONS

Prestroke shaft - basic setting:

Set control rod with adjusting screw (5) of device to CRT for start-of-delivery adjustment as per test-specification sheet (e.g. 10...11 mm).

Continue: B19/1 Fig.: B18/2



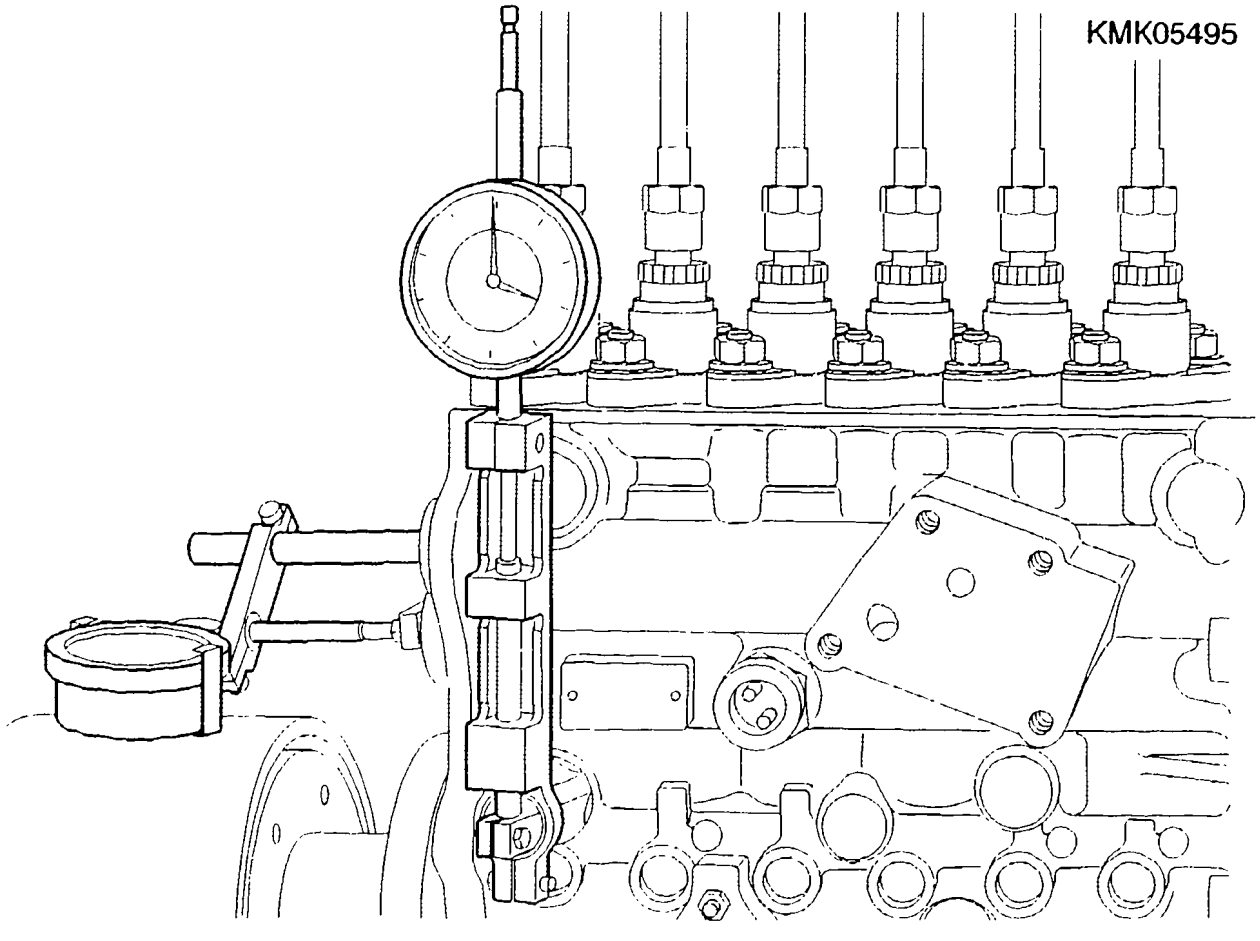
TEST AND ADJUSTMENT INSTRUCTIONS

Prestroke shaft - basic setting:

Set camshaft/roller tappet at start-of-delivery adjustment barrel to BDC.

Attach prestroke measuring device and set to 0.

Continue: B20/1 Fig.: B19/2



TEST AND ADJUSTMENT INSTRUCTIONS

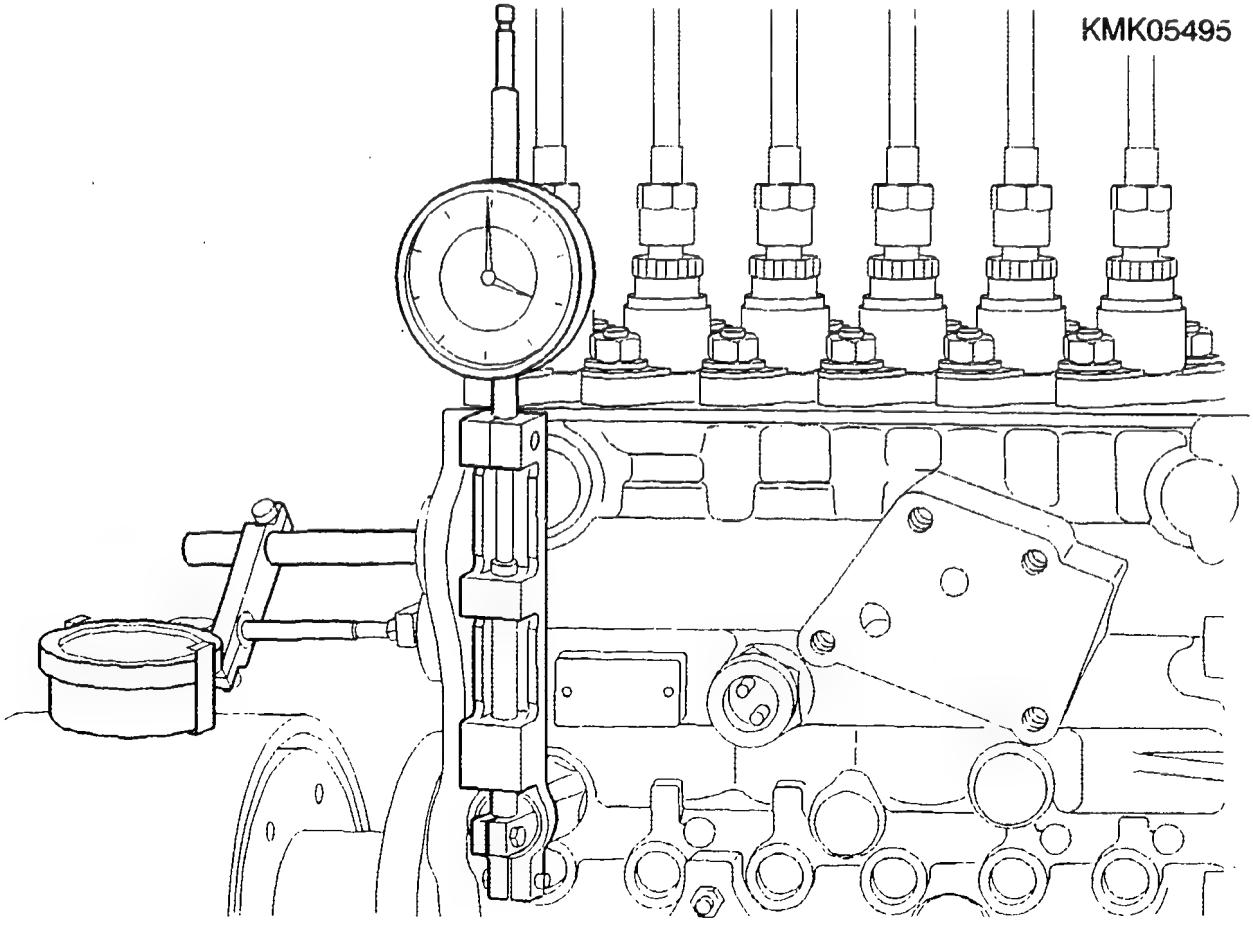
Prestroke shaft - basic setting:

By turning camshaft in direction of rotation set prestroke to following value (same for all versions):

"Start of delivery with prestroke MAX" as per test-specification sheet - minus 2.35 mm.

Example:
Start of delivery with prestroke MAX as per test-specification sheet = 7.0 mm.
Setting: 7 - 2.35 = 4.65 mm.

Continue: B21/1 Fig.: B20/2



TEST AND ADJUSTMENT INSTRUCTIONS

Prestroke shaft - basic setting:

Set pointer of test-bench graduated disk with correctly adjusted prestroke to theoretically most favorable zero value (for testing angular cam spacing).

Switch on test bench and test start of delivery at adjustment barrel (droplet method, inlet pressure as per test-specification sheet).
Start of delivery must coincide with set prestroke (see graduated disk - zero value).

Maximum tolerance = +/- 0.5 Grad.

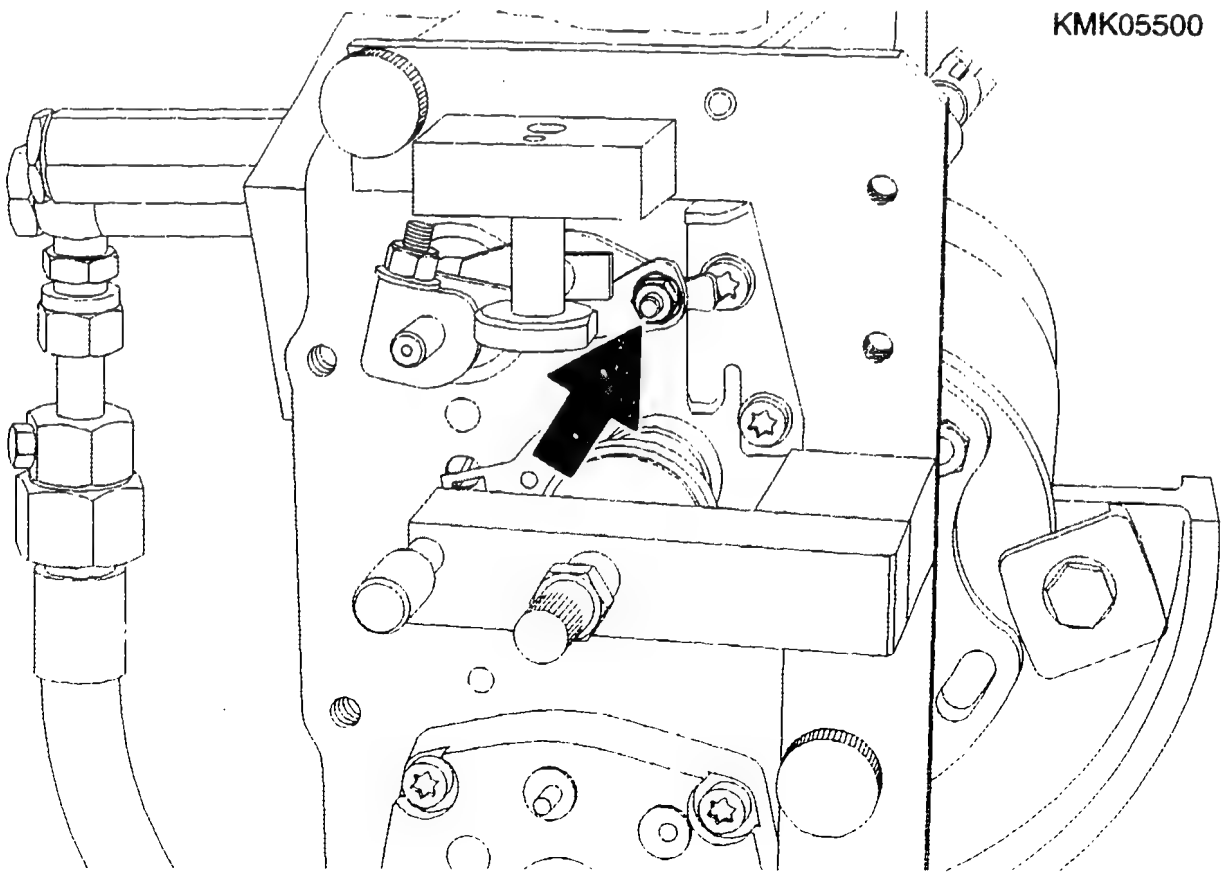
Continue: B22/1

Prestroke shaft - basic setting:

If angle deviation is excessive, perform correction in slot area of two-piece prestroke control lever.
To do so, loosen self-locking nut (arrow). Adjust outer control lever - and thus prestroke shaft - in area of slot such that start of delivery and prestroke coincide.
Then tighten self-locking nut to 6...7 Nm.

Remove prestroke measuring device as otherwise further turning would destroy it.

Continue: B23/1 Fig.: B22/2



TEST AND ADJUSTMENT INSTRUCTIONS

Checking angular cam spacing:

Check angular cam spacing (start of delivery of each barrel, cam sequence and angular spacing in degrees; see test-specification sheet).
Maximum tolerance = +/- 0.5 Grad.

Note down angle deviations for each barrel.

OK?

Yes: C06/1 No: B24/1

TEST AND ADJUSTMENT INSTRUCTIONS

Adjusting angular cam spacing:

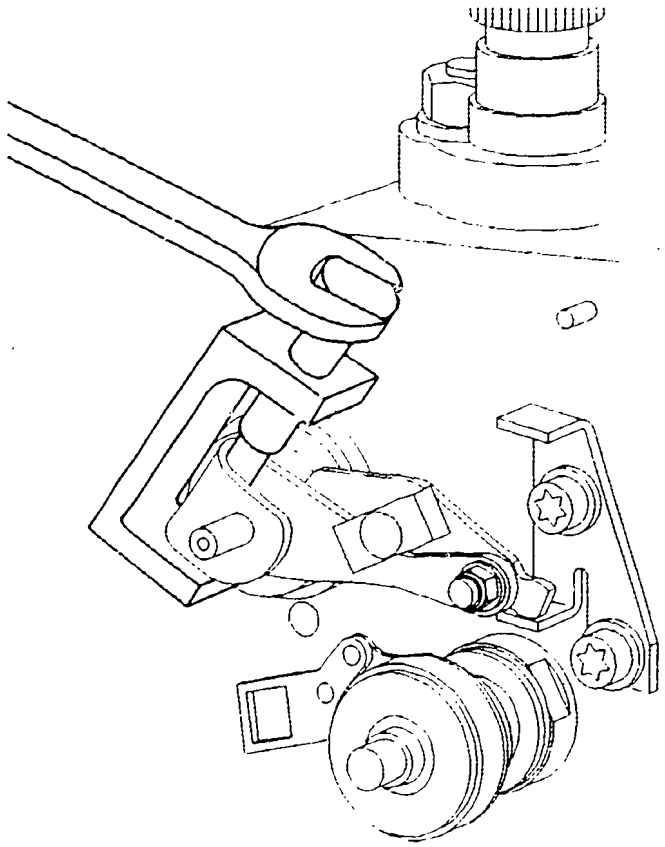
Adjust by changing shims beneath drivers (riders) of prestroke shaft.

To do so, remove prestroke shaft as follows:

* Remove adjustment gauge.
* Unscrew self-locking nut of wedge screw of prestroke control lever. Remove washer.
* Loosen wedge screw with disassembly tool 0 986 612 640 (see fig.).
* Pull control lever off prestroke shaft and remove washer.

Continue: B25/1 Fig.: B24/2

KMK05590



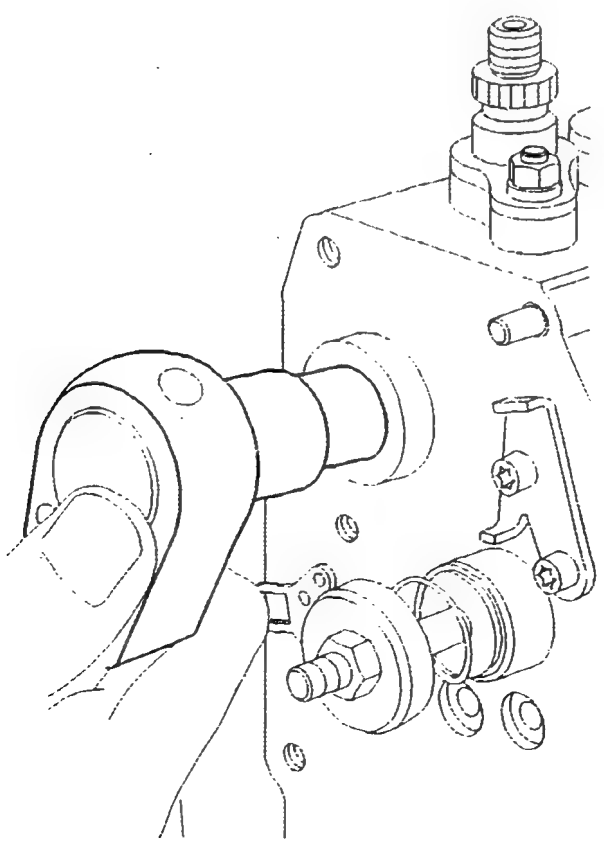
Adjusting angular cam spacing:

Removing prestroke shaft:

* Screw out threaded ring of prestroke shaft bearing with assembly wrench 0 986 612 643 (thread is micro-encapsulated; heat with hot-air blower if necessary).
* Pull prestroke shaft complete with bearing out of pump housing.
  Attention: Calibrating oil emerges.
  Before removing bearing from shaft, insert assembly sleeve 0 986 612 639 into bearing as far as it will go (to protect internal seal ring).

Continue: B26/1 Fig.: B25/2

KMK05591



TEST AND ADJUSTMENT INSTRUCTIONS

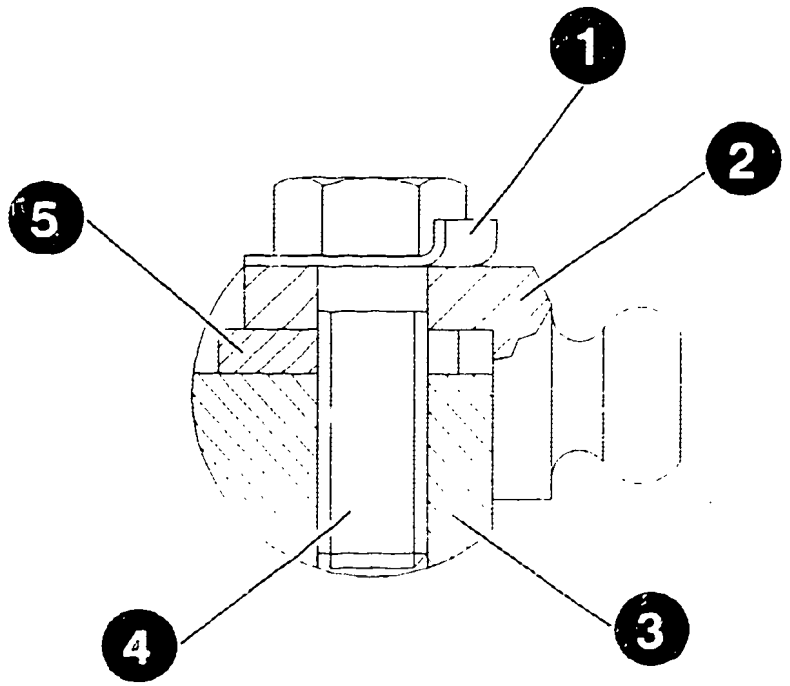
Adjusting angular cam spacing:

1 = Lock washer
2 = Driver (rider)
3 = Prestroke shaft
4 = Hexagon bolt
5 = Shim

Bend open lock washer at drivers to be corrected and screw out screw. Replace shim between driver and pre-stroke shaft with one of appropriate thickness.
Continued on next Coordinate.

Continue: B27/1 Fig.: B26/2

KMK05580



TEST AND ADJUSTMENT INSTRUCTIONS

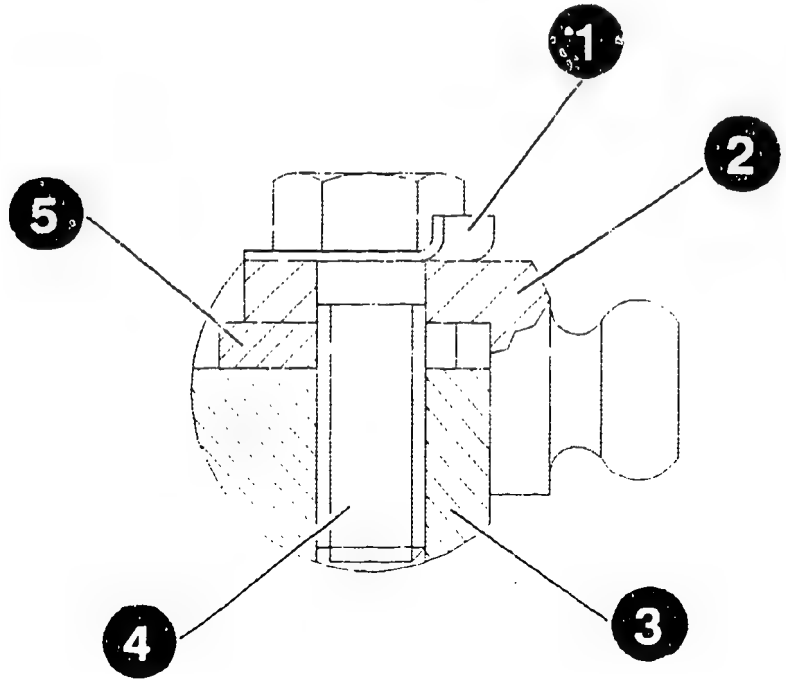
Adjusting angular cam spacing:

Alteration in shim thickness:
1 change in angle corresponds to 0.4 mm shim thickness.
Example: With start of delivery 1 too soon, shim 0.4 mm thicker and vice versa.

Tighten hexagon bolt to 5.5...6 Nm.
Bend round lock washers and ensure correct contact with hexagon head (bending direction in direction "tighten bolt").

Continue: B28/1 Fig.: B27/2

KMK05580



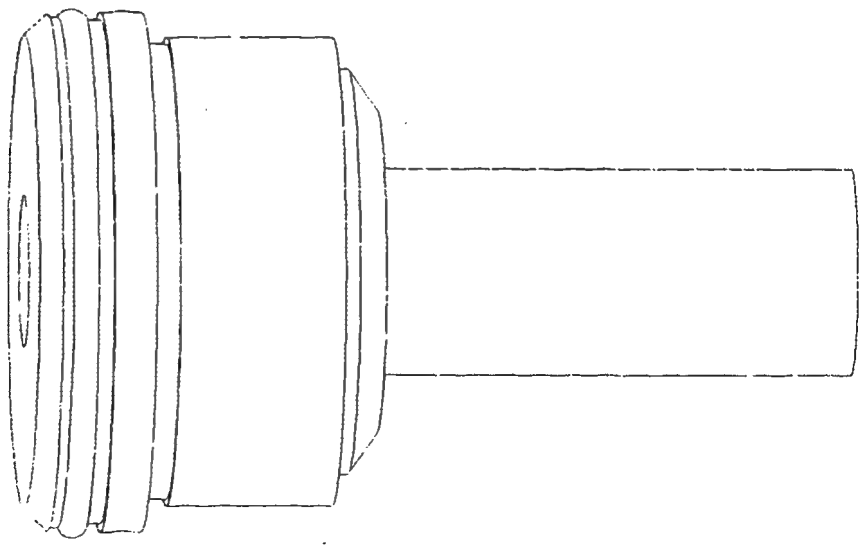
Adjusting angular cam spacing:

Re-installing prestroke shaft:

* If necessary, clean threaded ring of prestroke shaft bearing and thread in pump housing (already performed if pump has previously been repaired).
* Apply tallow to outer O-ring of prestroke shaft bearing.
* Slightly lubricate assembly sleeve 0 986 612 639 to protect internal seal ring and insert into bearing as far as stop.

Continue: C01/1 Fig.: B28/2

KMK05302

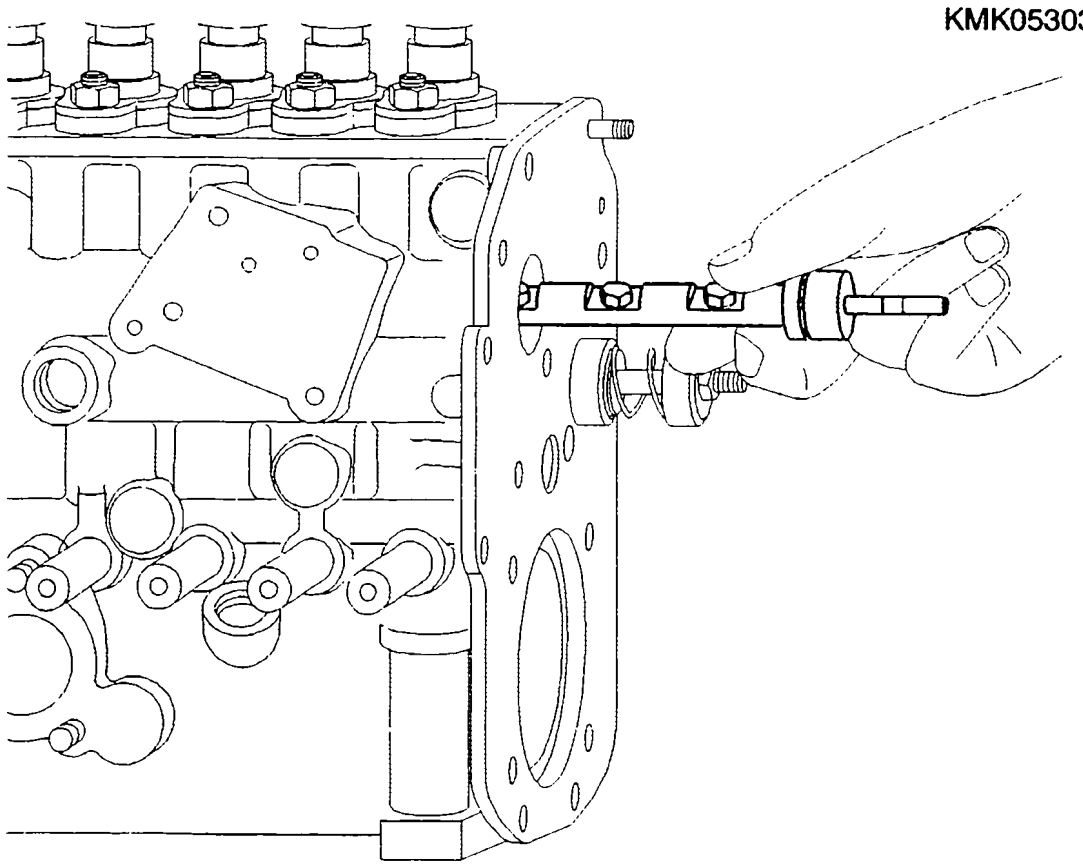


Adjusting angular cam spacing:

Re-installing prestroke shaft:
Attach prestroke shaft bearing with assembly sleeve to prestroke shaft and insert complete unit into pump.
Proceed carefully; do not exert force.
Driver ball heads must engage in driver groove of control levers; shaft must be inserted into drive-end bearing.

Press bearing into mount in pump housing as far as it will go.

Continue: C02/1 Fig.: C01/2

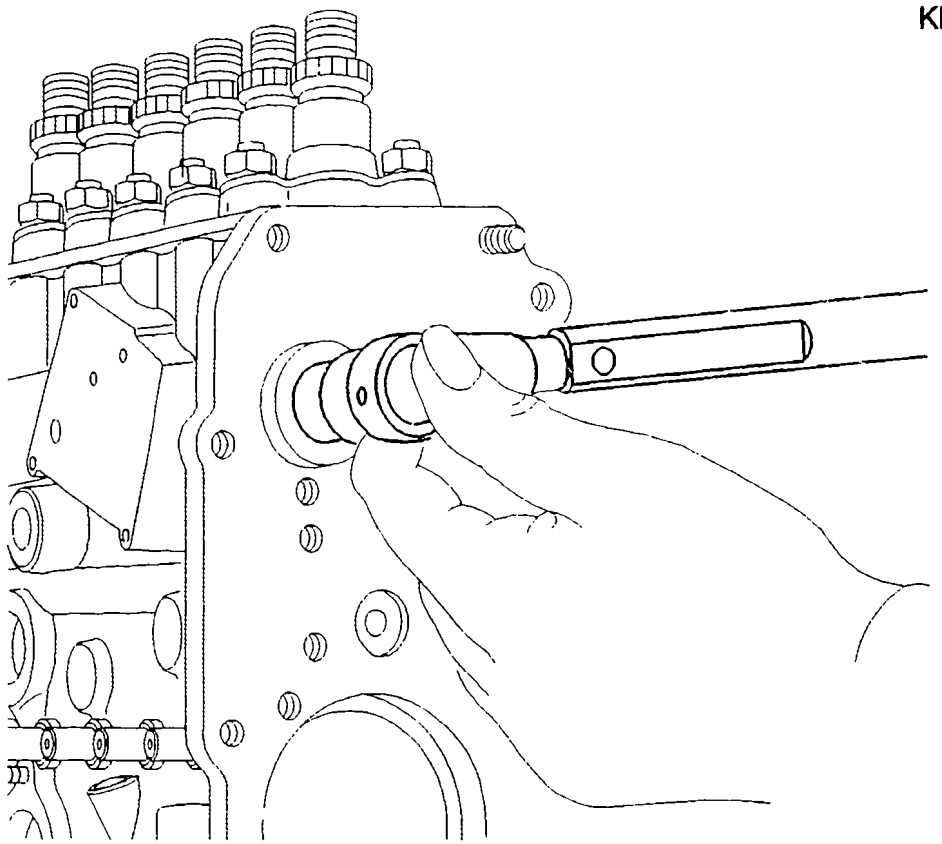


Adjusting angular cam spacing:

Re-installing prestroke shaft:
Apply Loctite to threaded ring for prestroke shaft bearing, screw in and tighten with assembly wrench
0 986 612 643 to 30...40 Nm.

Continue: C03/1 Fig.: C02/2

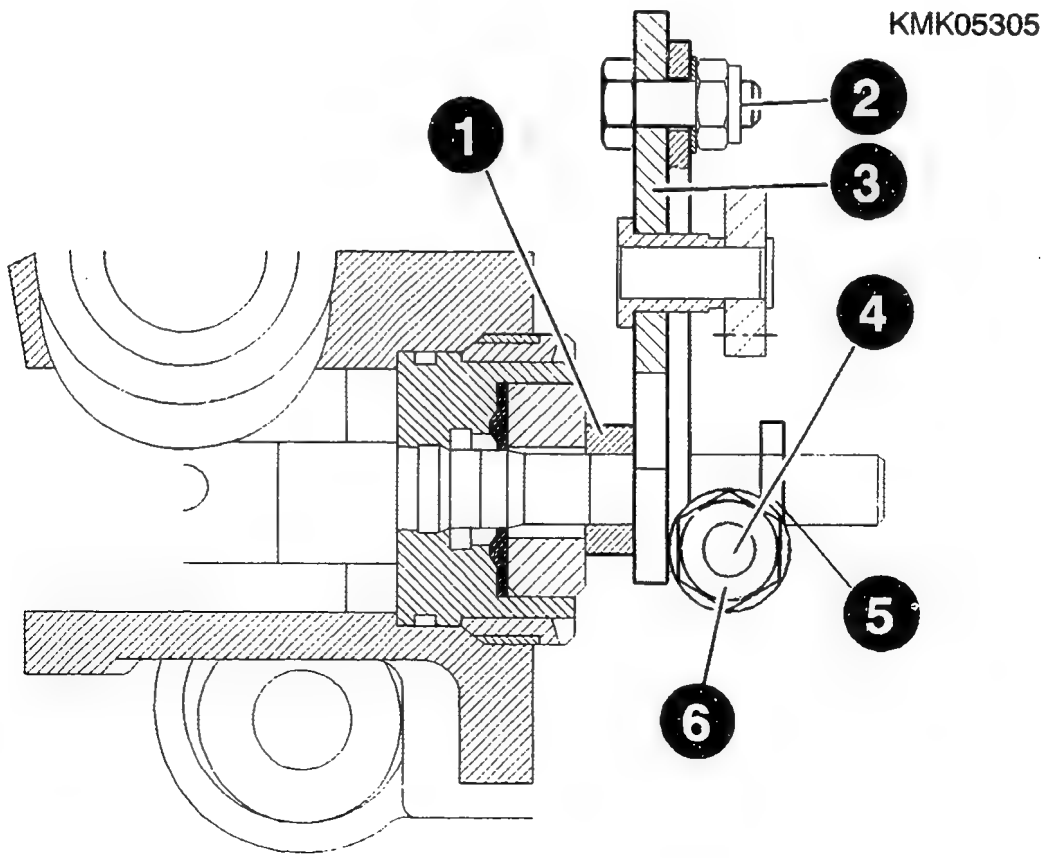
KMK05304



Adjusting angular cam spacing:

Installing control lever - prestroke shaft:
Fit washer (1). Loosen correction screw (2) at two-piece control lever and slip loose lever (3) first onto shaft. If stiff, loose lever may have to be straddled somewhat.
Turn lever such that wedge screw (4) can be inserted from underneath in clamping bracket (5). Place washer and new self-locking nut (6) in position and fasten loosely.

Continue: C04/1 Fig.: C03/2



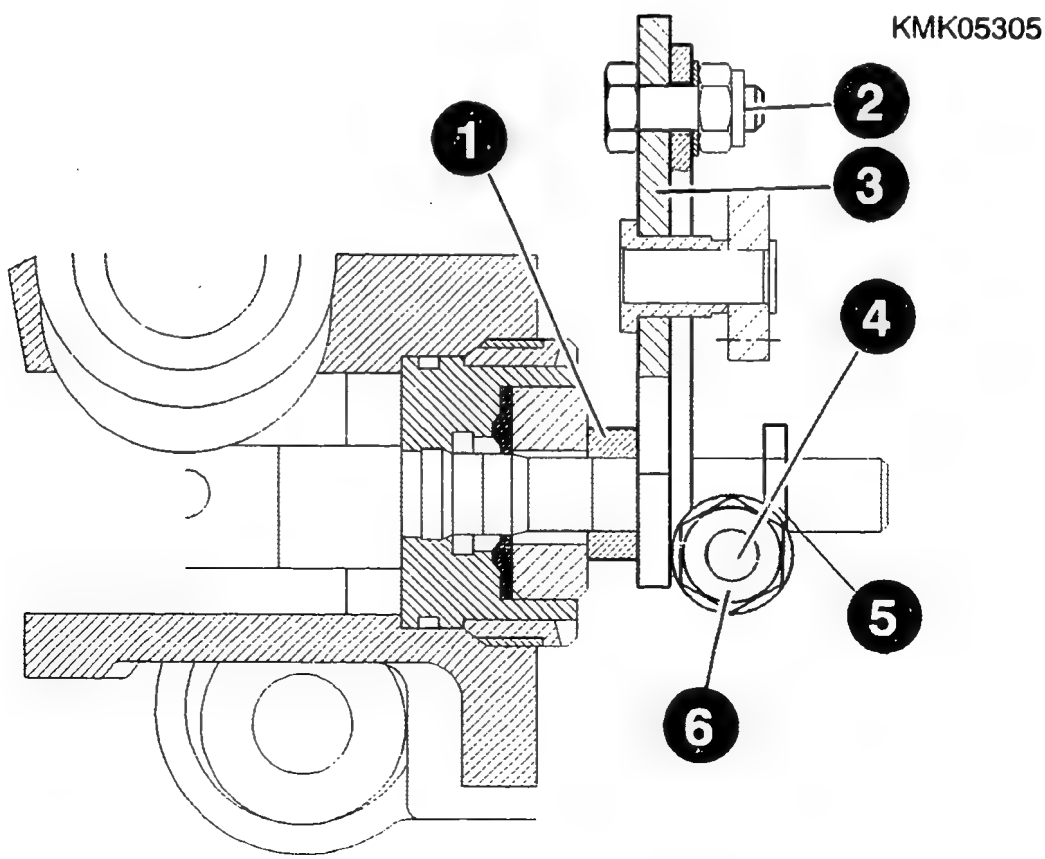
TEST AND ADJUSTMENT INSTRUCTIONS

Adjusting angular cam spacing:
Adjusting prestroke-shaft
axial clearance:

Axial-clearance set value:
0.10...0.15 mm.

Pull prestroke shaft outwards as far as it will go and simultaneously push control lever against washer so that prescribed clearance is maintained. Check with feeler gauge between loose lever (3) and washer (1). 0.10 mm gauge must be easy to insert, 0.15 mm gauge difficult. Tighten nut (6) to torque of 6...7 Nm.

Continue: C05/1 Fig.: C04/2



TEST AND ADJUSTMENT INSTRUCTIONS

Adjusting angular cam spacing:

Test prestroke shaft with control lever by way of drop test for freedom of movement. Lever must drop from upper to lower position by virtue of its own weight.

Repeat prestroke adjustment and testing of start of delivery/angular cam spacing.
As of Coordinate: B17/1

Note: If measurement and adjustment have been performed properly, it will not be necessary to remove the pre-stroke shaft again.

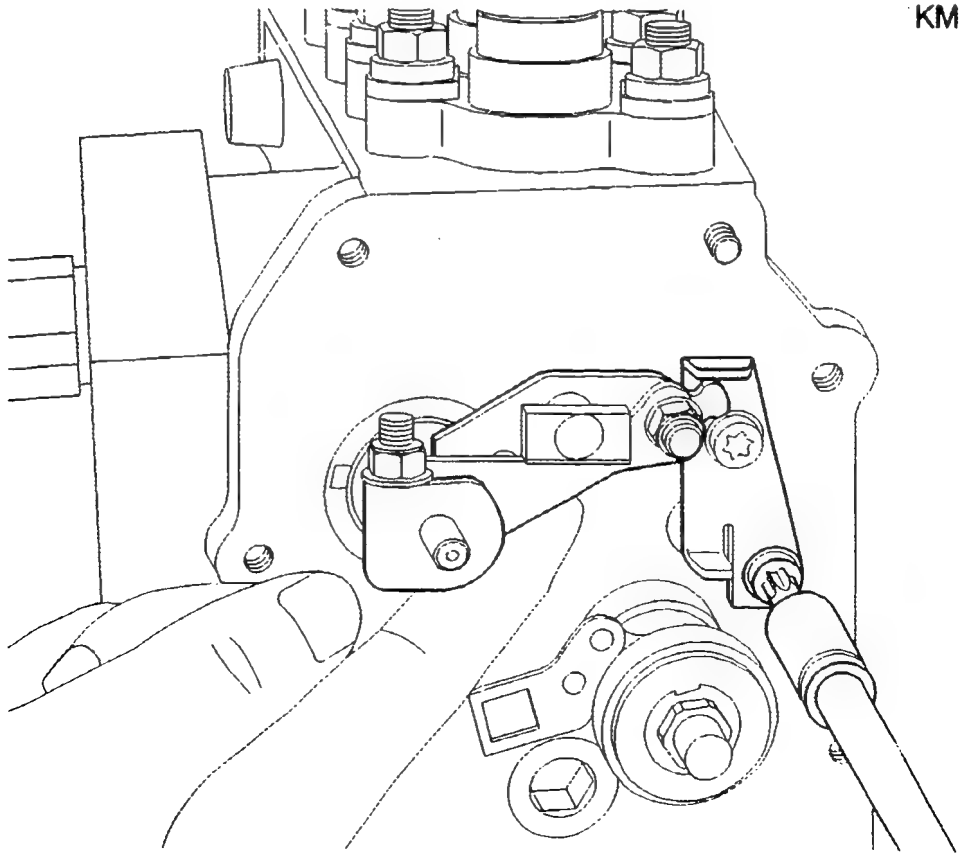
Continue: C06/1

TEST AND ADJUSTMENT INSTRUCTIONS

Installing and adjusting control-lever stop:

* Set camshaft/roller tappet at adjustment barrel to BDC.
* Fit prestroke measuring device and set dial indicator to 0.
* Fit control-lever stop and slightly tighten screws.
* Set prestroke by turning camshaft to value "Start of delivery with prestroke MAX" as per test specification sheet.

Continue: C07/1 Fig.: C06/2



TEST AND ADJUSTMENT INSTRUCTIONS

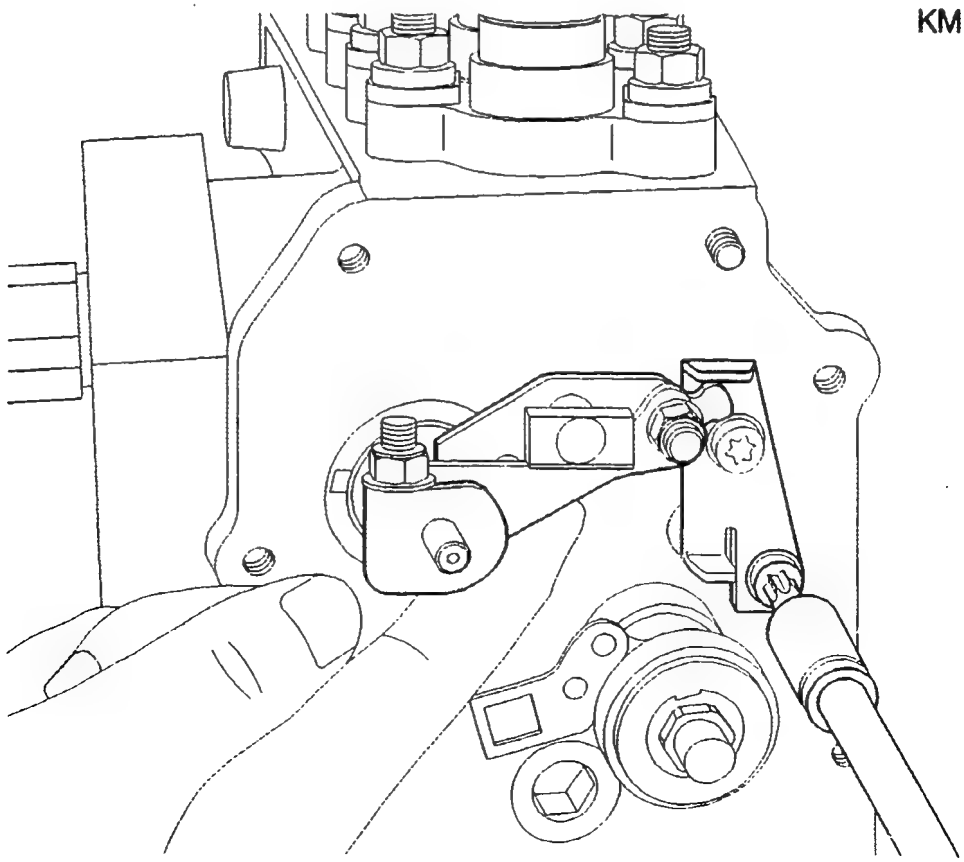
Installing and adjusting control-lever stop:

Adjusting upper stop (MAX stop):

* With prestroke correctly adjusted, turn prestroke shaft at control lever such that start of delivery is set.
* In this setting, cause upper stop to make contact with control lever and tighten stop fastening screws to 5...7 Nm.

Continue: C08/1 Fig.: C07/2

KMK05501



TEST AND ADJUSTMENT INSTRUCTIONS

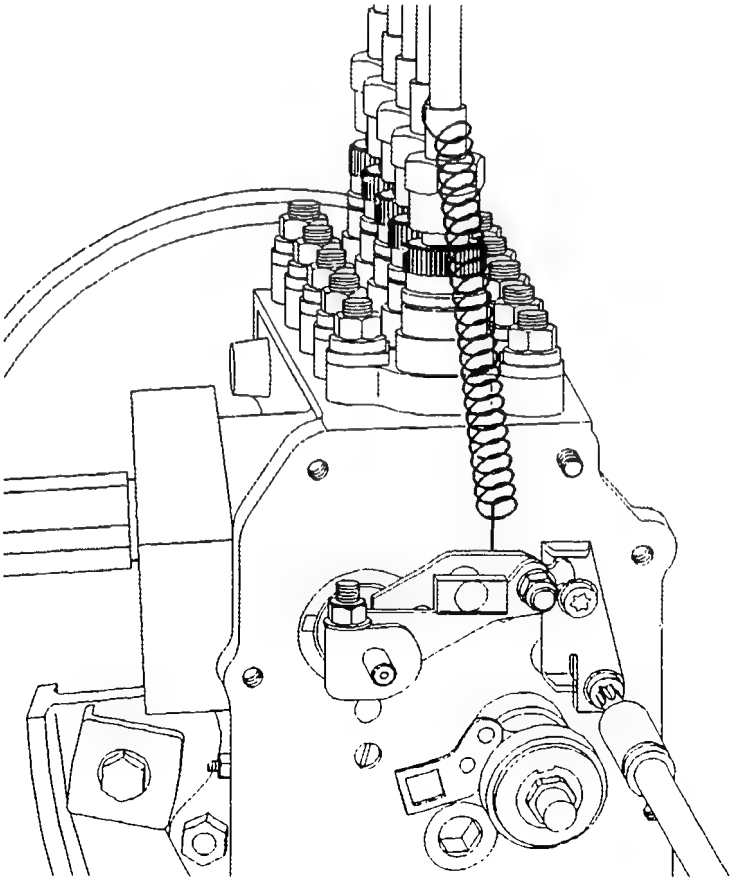
Installing and adjusting control-lever stop:

Perform cross-check "Prestroke at start of delivery":

* Position control lever with spring at upper stop.
* Turn camshaft as far as start of delivery and measure resultant prestroke.
* Start of delivery and prestroke must coincide. Permissible prestroke tolerance: +/- 0.05 mm.

Continue: C09/1 Fig.: C08/2

KMK05483

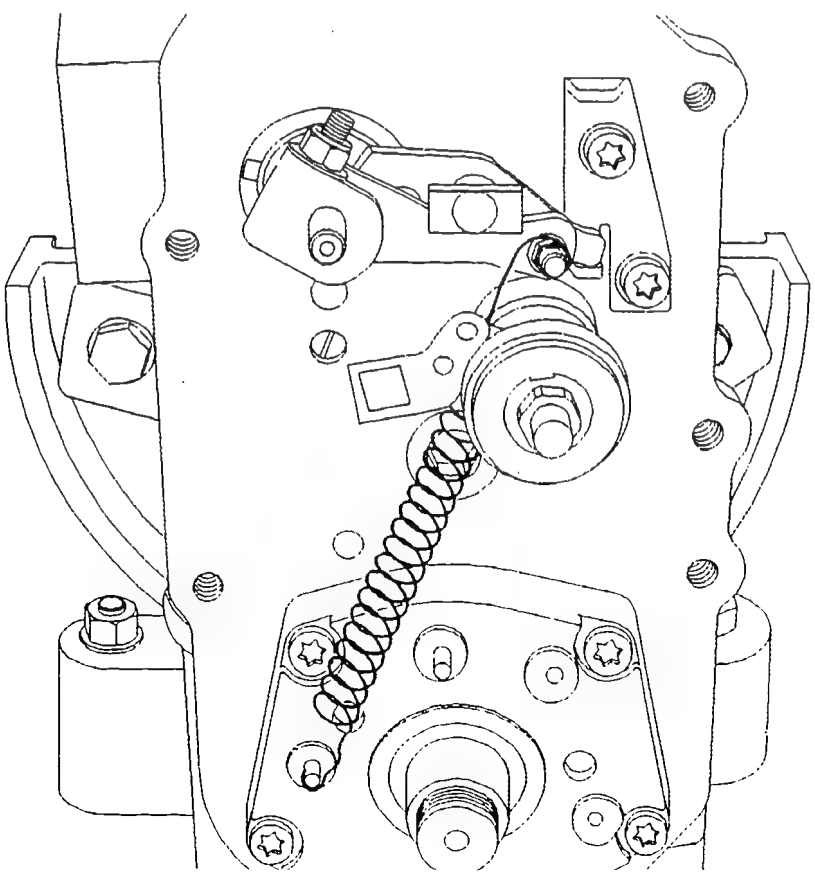


TEST AND ADJUSTMENT INSTRUCTIONS

Testing lower control-lever stop (MIN stop):

* Position control lever with spring at lower stop.
* Determine start of delivery by turning camshaft and measure resultant prestroke.
* Set value: "Start of delivery with prestroke MAX" as per test specification sheet minus 6.2 +/- 0.15 mm. (Value 6.2 mm always the same).
  Example: "Start of delivery as per test-specification sheet 7.0 mm.
  Prestroke set value:
  7.0 - 6.2 = 0.8 (+/- 0.15) mm.
* If result outside tolerance:
  Incorrect or bent stop.

Continue: C10/1 Fig.: C09/2



TEST AND ADJUSTMENT INSTRUCTIONS

Installing oil pump and disk cam (Injection pumps with oil pump only, see replacement parts list):

Note: It is assumed that oil pump and disk cam have been visually inspected within the scope of pump repairs and that the correct parts are installed. Refer to repair instructions for detailed information.

Continue: C10/2

TEST AND ADJUSTMENT INSTRUCTIONS

Installing oil pump and disk cam:

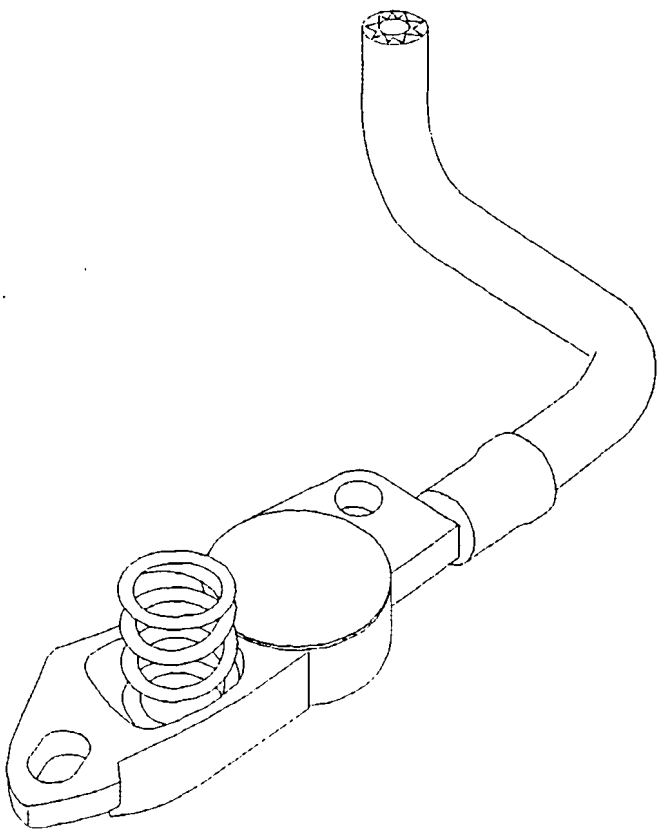
Use cleaner to clean taper of camshaft, tapered bore of disk cam and fastening nut. All parts must be completely free of grease and dry.

Continue: C11/1

Installing oil pump and disk cam:

Insert oil-pump spring with small quantity of hot bearing grease in mount on back of pump.

Continue: C12/1 Fig.: C11/2

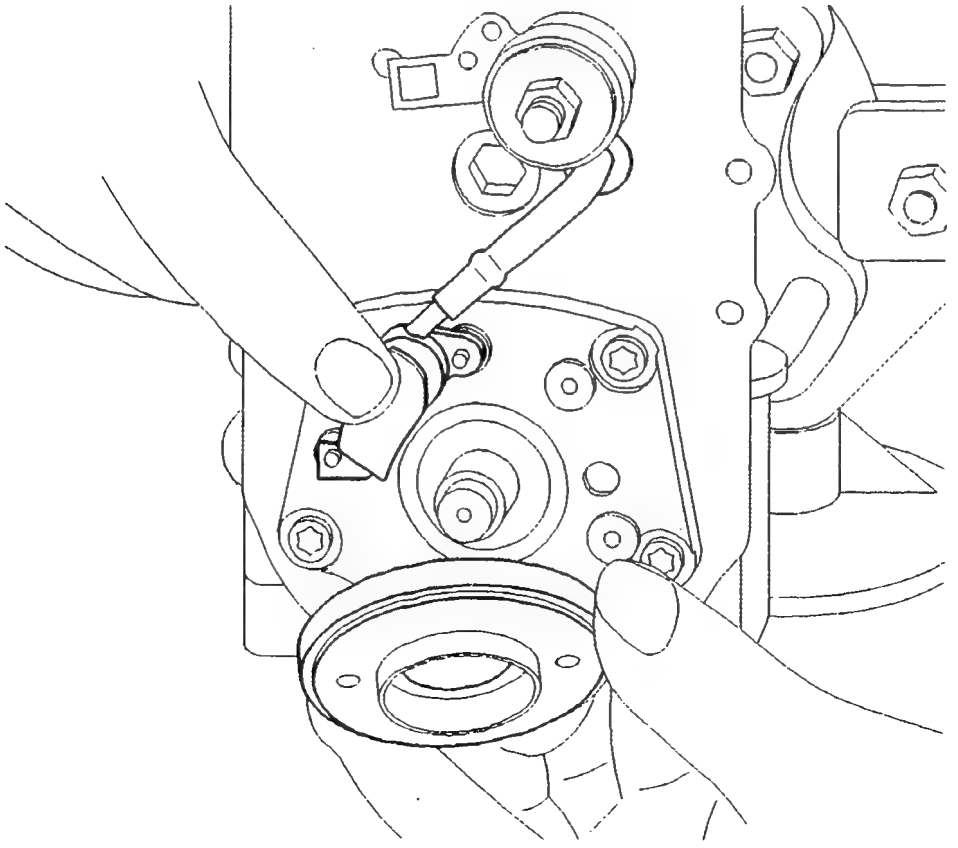


Installing oil pump and disk cam:

Place oil pump on the two guide pins in the end shield and hold. Place disk cam on taper of camshaft and hold. Screw on nut and tighten slightly. (It should still be possible to turn the disk cam). Attach oil hose to hose connection.

Check whether oil pump is pressed against bearing surface of disk cam by spring force and whether it is easy to move.

Continue: C13/1 Fig.: C12/2



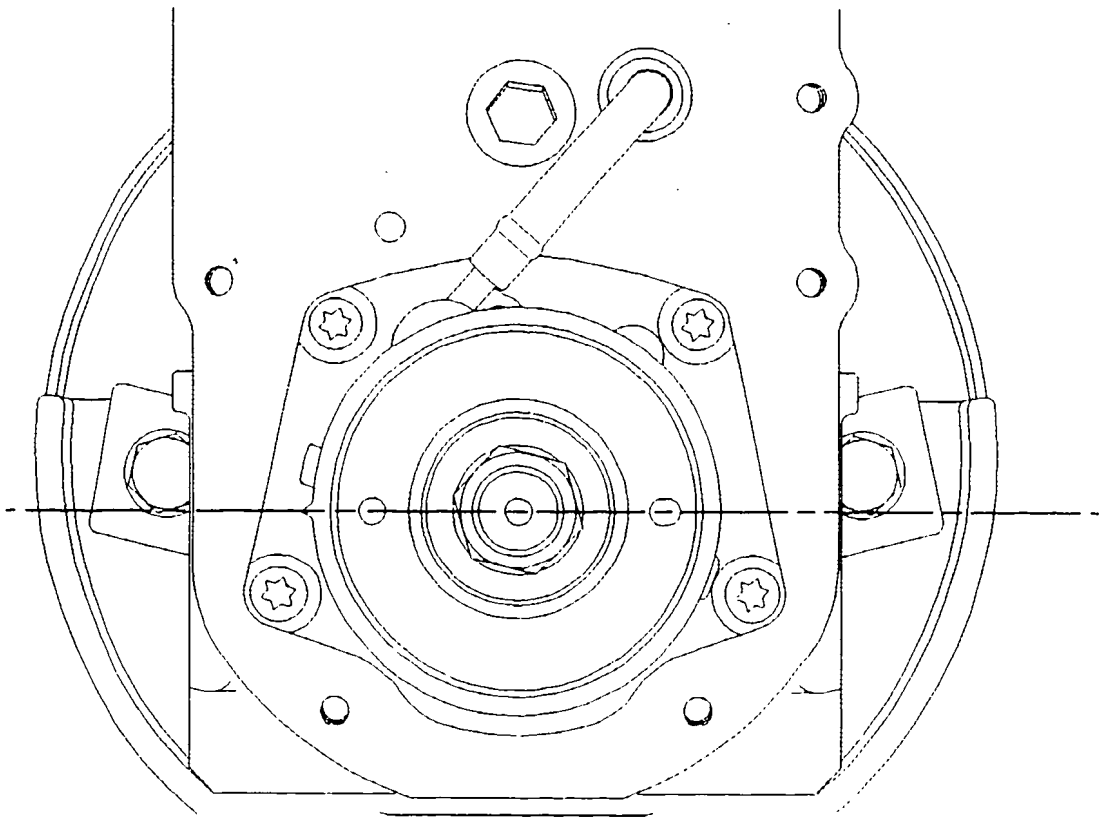
KMK05329

Adjusting disk cam (start-of-delivery cam):

* Position control lever of prestroke shaft at lower stop.
* Adjust camshaft to customer-specific setting for disk cam (prestroke ...mm at start-of-delivery adjustment barrel).
* Turn disk cam so that adjustment cam is exactly horizontal with center of camshaft in direction of supply-pump end. Hold disk cam in this position and tighten fastening nut to 90...100 Nm.

Continue: C14/1 Fig.: C13/2

KMK05480



Calibration of spindle in injected-quantity adjusting-magnet armature - dimension "X":

Dimension "X" = clearance between spindle and control rod with positioner fitted.
Set value: 0.1...0.3 mm.
Measure and calculate dimension "X" as follows:

Continue: C15/1

TEST AND ADJUSTMENT INSTRUCTIONS

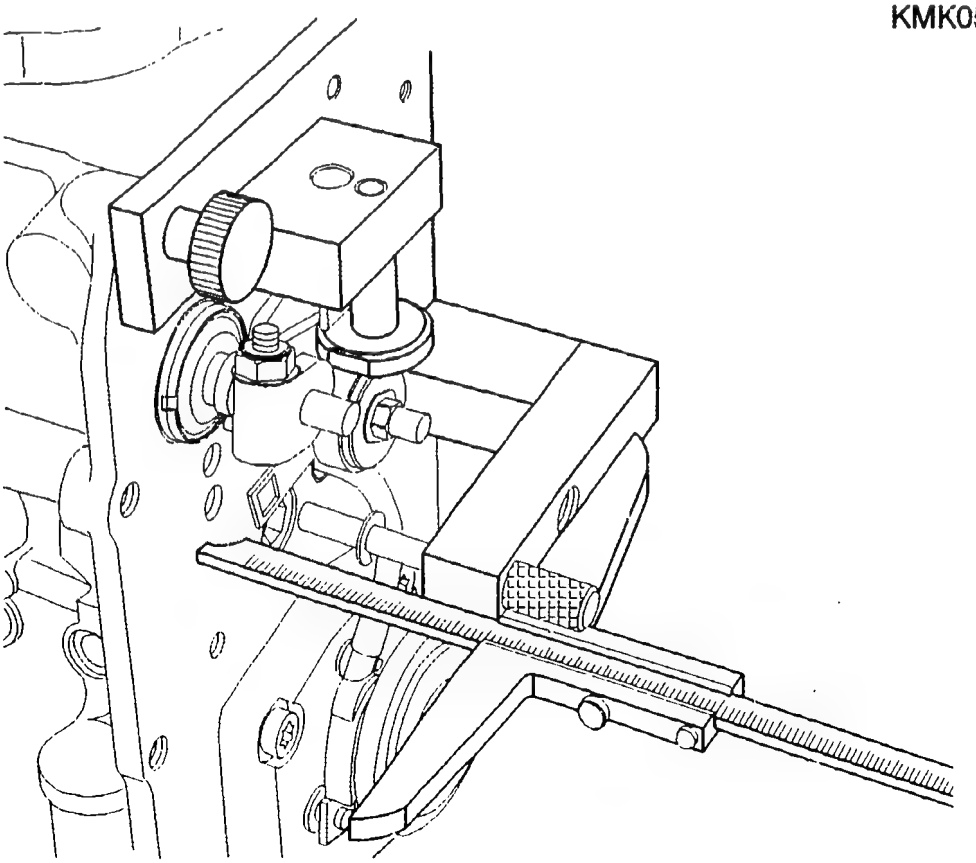
Calibrating dimension "X":

1. Dimension "A" (projection: control rod - pump end face):

* Press control rod by hand onto start-position stop and block at CRT measuring device.
* Attach adjustment device 0 986 612 620 (pay attention to driver mount). Screw out thrust screw of device for control rod.
* Use depth gauge to precisely measure distance between device bracket and pump end face - gives dimension "a 1".

Continue: C16/1 Fig.: C15/2

KMK05494



TEST AND ADJUSTMENT INSTRUCTIONS

Calibrating dimension "X":

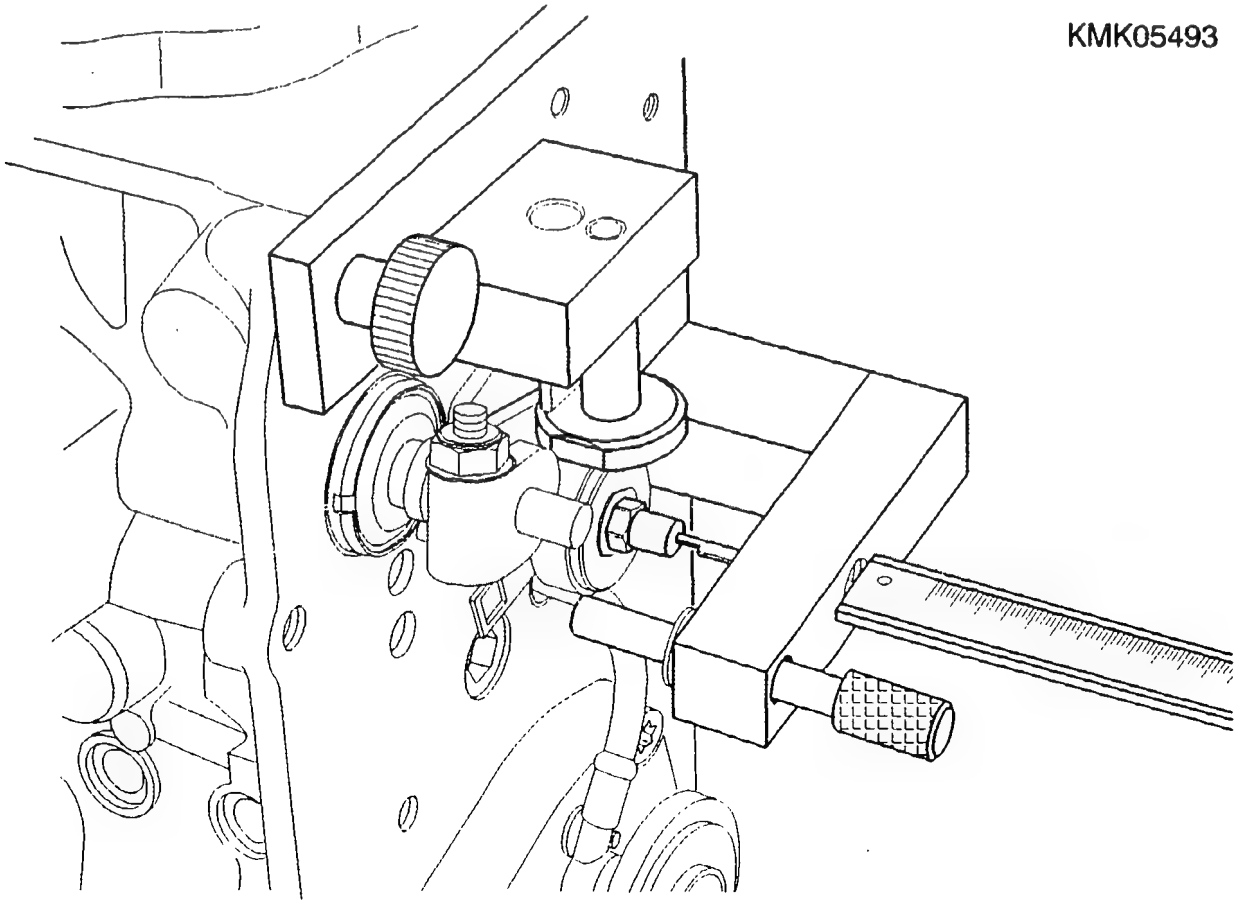
* Use depth gauge to precisely measure distance between device bracket and cap nut of control rod through threaded hole for thrust screw - gives dimension "a 2".

* Calculating dimension "A":

  a 1 - a 2 = dimension "A".

  Note down dimension "A".

Continue: C17/1 Fig.: C16/2



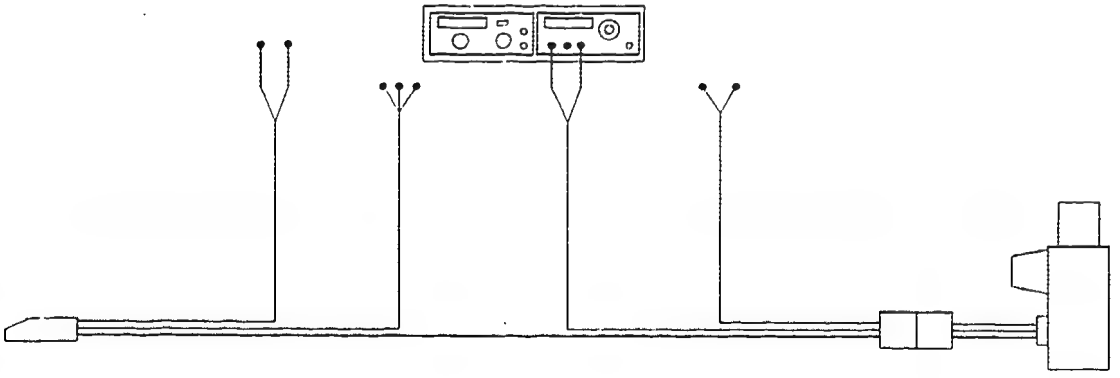
Calibrating dimension "X":

2. Dimension "B" (position of armature in positioner in start position):

* Connect version-specific adapter lead 0 986 610 ... and universal test lead 0 986 610 102 to positioner (fig.).
* Connect lead to positioner red (+) - black (-) of universal test lead to regulator 12 V/ 15 A, but do not switch on.

Continue: C18/1 Fig.: C17/2

KMK05581



TEST AND ADJUSTMENT INSTRUCTIONS

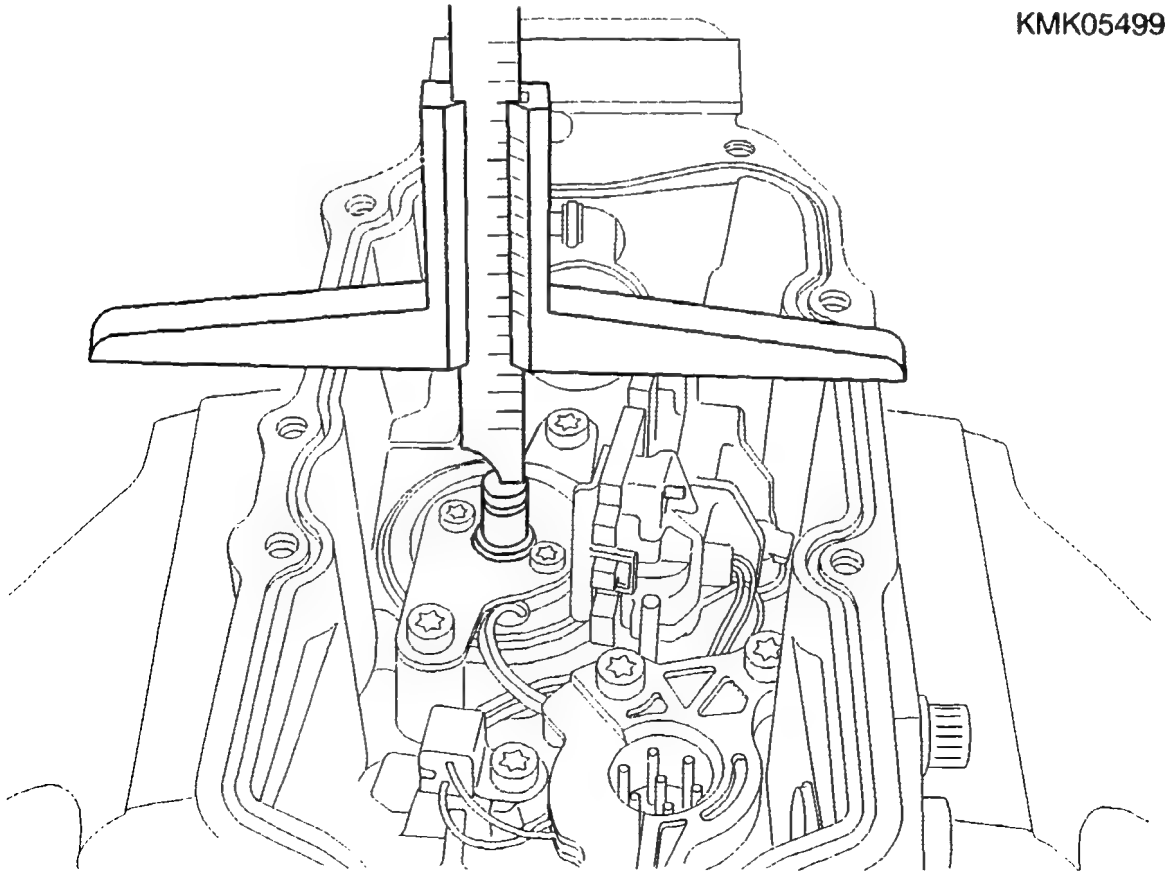
Calibrating dimension "X":

* Place positioner on suitable surface with opening facing upwards.
* Switch on regulator and set current such that armature extends as far as stop.
* Use depth gauge to measure distance between positioner attachment surface (without seal) and spindle of armature.

  Attention: Duration of current application max. 1 minute on account of warm-up of solenoid.

* Measurement result = dimension "B".

Continue: C19/1 Fig.: C18/2



TEST AND ADJUSTMENT INSTRUCTIONS

Calibrating dimension "X":

* Calculate dimension "X"
* Dimension B minus A = X.

Adjustment:

X too big: Fit appropriately larger spindle in armature and vice versa. Refer to next Coordinate for procedure involved.
Example: Dimension X measured = 0.6 mm:
Fit 0.4 mm longer spindle
(gives dimension X = 0.2 mm).

Continue: C19/2

TEST AND ADJUSTMENT INSTRUCTIONS

Adjusting dimension "X":
Use pliers to pull off armature spindle (held by snap ring) and press spindle of appropriate dimension group (dimension groups with 0.2 mm gradation as per replacement parts list) together with snap ring into armature as far as they will go.

Adjustment with new magnet (supplied without spindle):
Select new spindle 0.1...0.3 mm smaller than calculated dimension "X" and press with snap ring into armature as far as it will go.

Continue: C20/1

TEST AND ADJUSTMENT INSTRUCTIONS

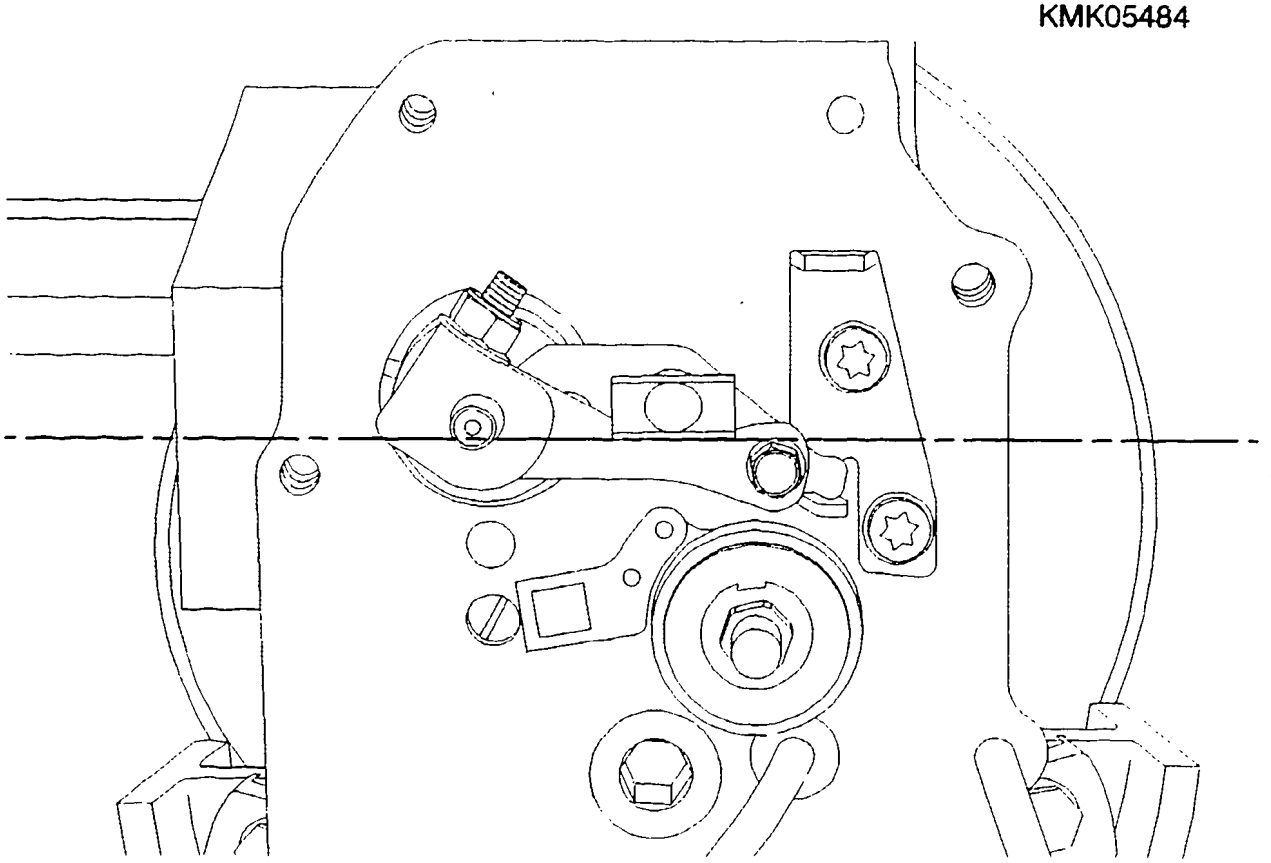
Attaching positioner to injection pump:

Injection-pump preparation:

* Press control rod onto start-position stop and set CRT dial indicator to 21 mm (do not alter afterwards).
* Control lever of prestroke shaft must make contact with lower stop.
* Horizontally align (fig.) driver (propeller).

Continue: C21/1 Fig.: C20/2

KMK05484



TEST AND ADJUSTMENT INSTRUCTIONS

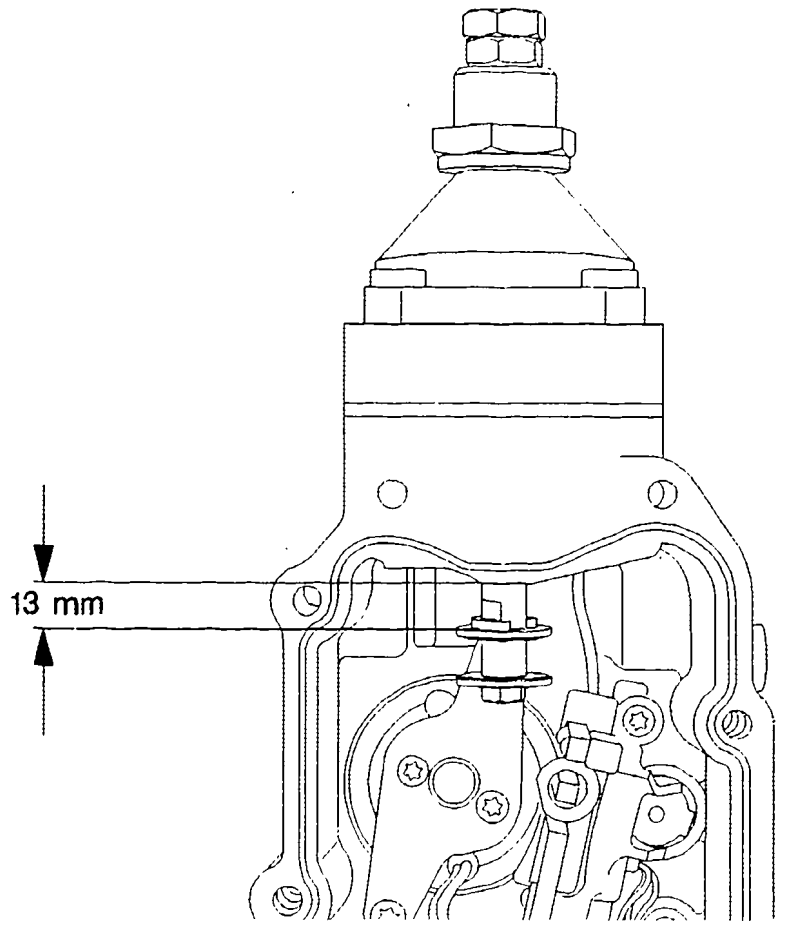
Attaching positioner to injection pump:

Positioner preparation:

* Unscrew housing cover over prestroke solenoid and replace it with test cover 0 986 612 676.
* Screw measuring device 0 986 612 657 with adjusting screw into cover.
* Use adjusting screw to set armature such that distance between top of drive roller (thread reel) and housing (see fig.) is 13 mm.

Continue: C22/1 Fig.: C21/2

KMK05496



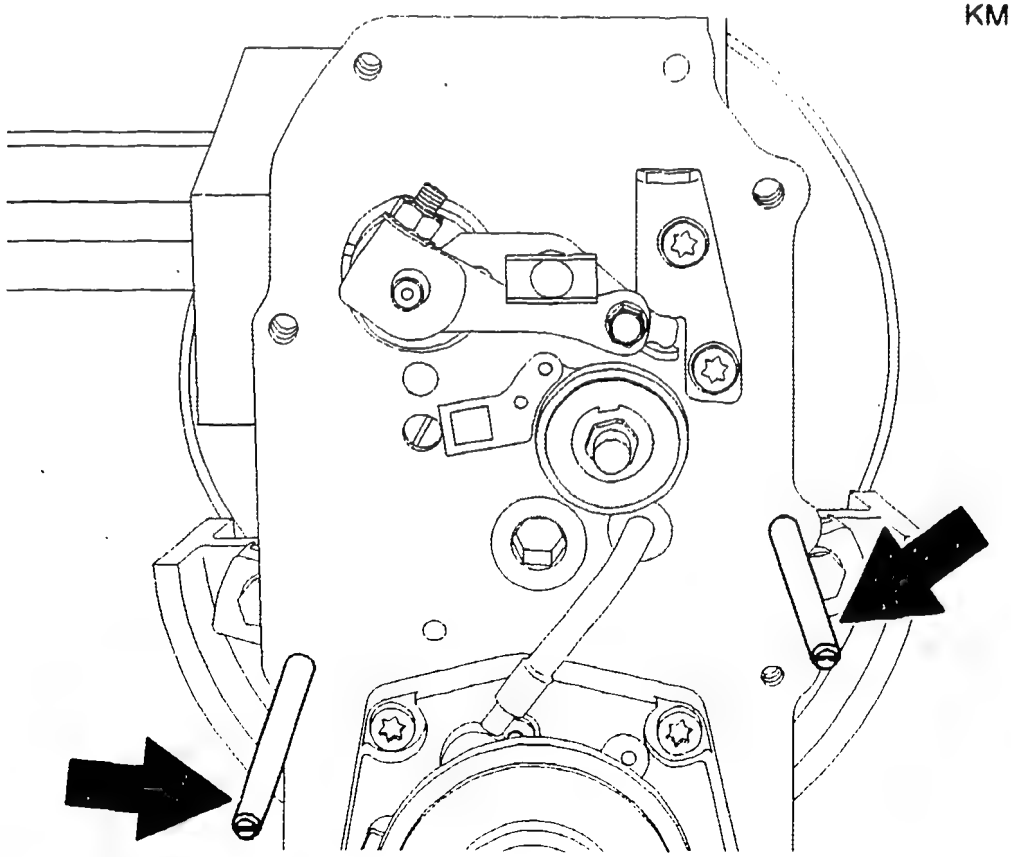
TEST AND ADJUSTMENT INSTRUCTIONS

Attaching positioner to injection pump:

* Screw the two guide pins 0 986 612 598 roughly on a level with control rod into corresponding positioner fastening holes in pump housing (fig., arrows).

Continue: C23/1 Fig.: C22/2

KMK05498



TEST AND ADJUSTMENT INSTRUCTIONS

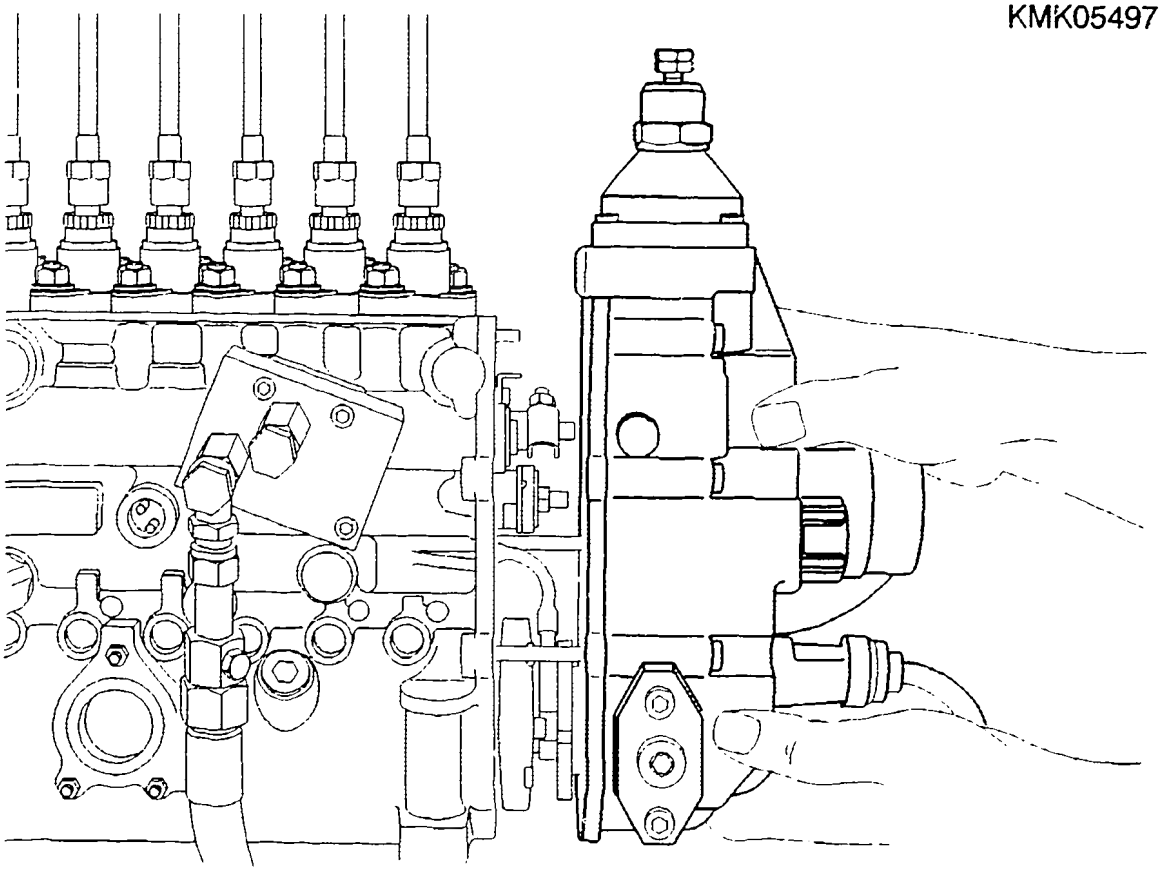
Attaching positioner to injection pump:

A T T E N T I O N:

As regards installation of the positioner on the injection pump as described below, it must be possible to guide the positioner housing without any resistance over the guide pins until contact is made with the pump housing. If resistance is felt, the drive roller is catching on the driver (propeller) of the control lever. Such a situation requires sensitive correction of the adjusting screw for the armature position.

Continue: C24/1 Fig.: C23/2

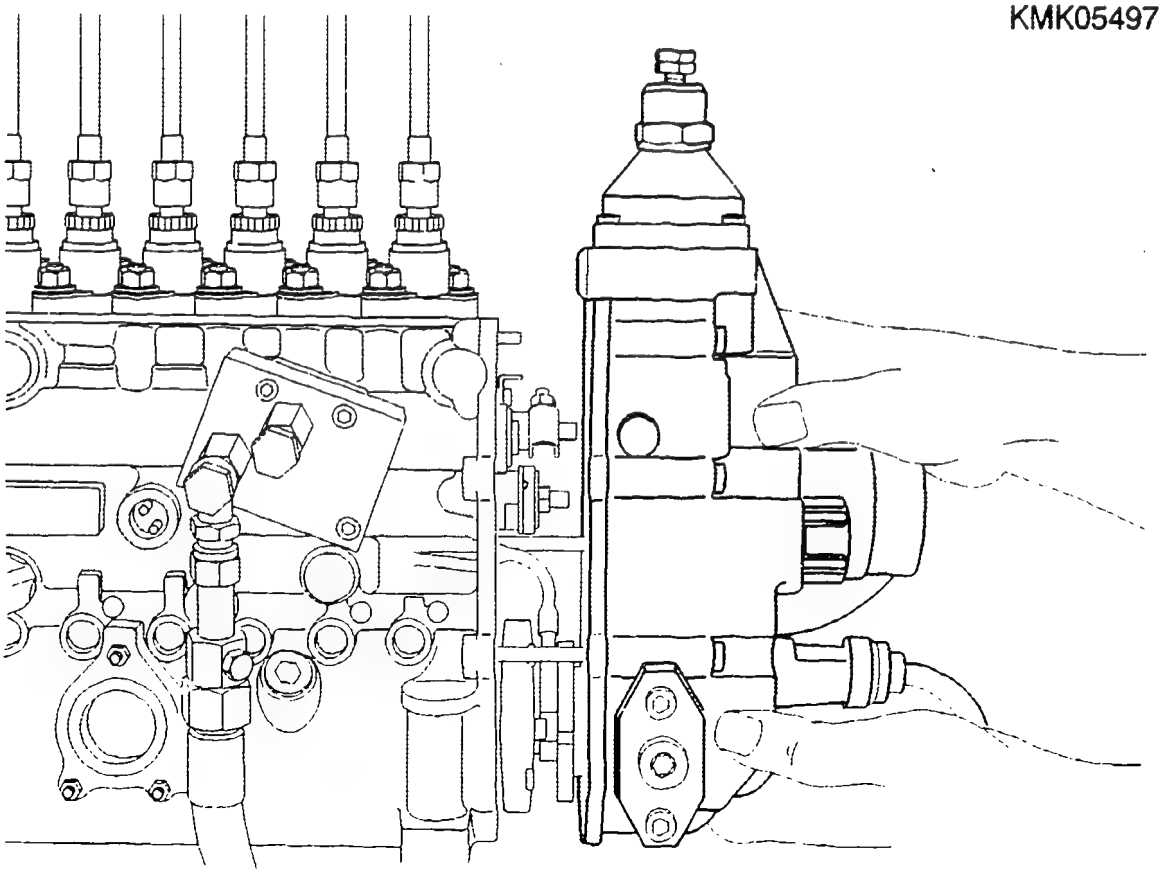
KMK05497



Attaching positioner to injection pump:

* Insert seal into groove in positioner housing; bond on with small quantity of grease.
* Axially locate positioner over guide pins and press onto pump housing.
  Attention: On attachment, pay attention to important information from preceding Coordinate.
  Likewise note that short-circuiting ring and measurement arm of RPS must not come into contact.

Continue: C25/1 Fig.: C24/2



Attaching positioner to injection pump:

* Screw in positioner fastening screws, then screw out guide pins and screw in remaining fastening screws.
* Tighten all screws to 7...9 Nm.

Continue: C26/1

TEST AND ADJUSTMENT INSTRUCTIONS

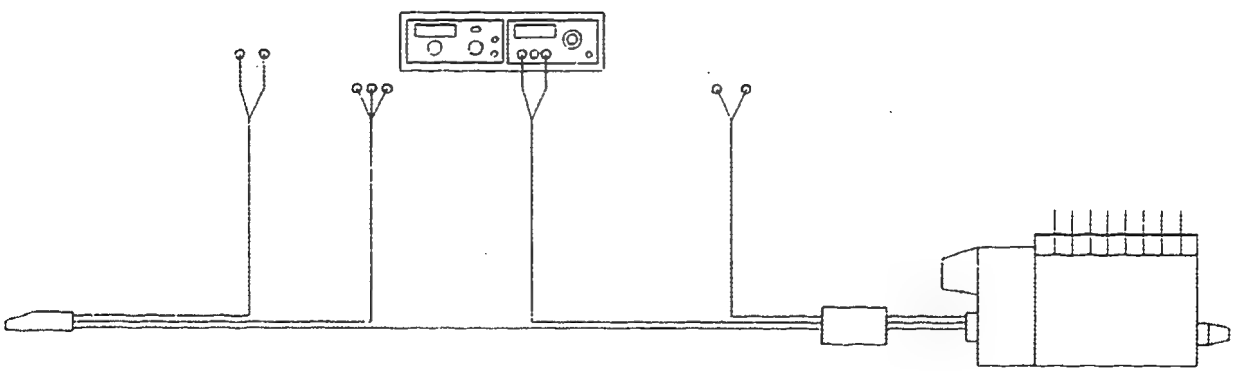
Checking dimension "X":

* Connect version-specific adapter lead 0 986 610 ... and universal test lead 0 986 610 102 to positioner.
* Connect lead to positioner red (+) - black (-) to regulator 12 V/ 15 A.
* Set current such that control rod goes to max. CRT.
  Desired CRT: 20.7...20.9 mm.

* Incorrect value: Dimension "X" not properly calibrated.

Continue: C27/1 Fig.: C26/2

KMK01057



TEST AND ADJUSTMENT INSTRUCTIONS

Checking prestroke MAX/MIN stops:

Note: Fitted positioner/prestroke positioner must not affect previously set adjustment range of prestroke-shaft control lever, i.e. when prestroke solenoid is deenergized, control lever must be at upper stop and vice versa.

For testing refer to following Coordinate.

Continue: C28/1

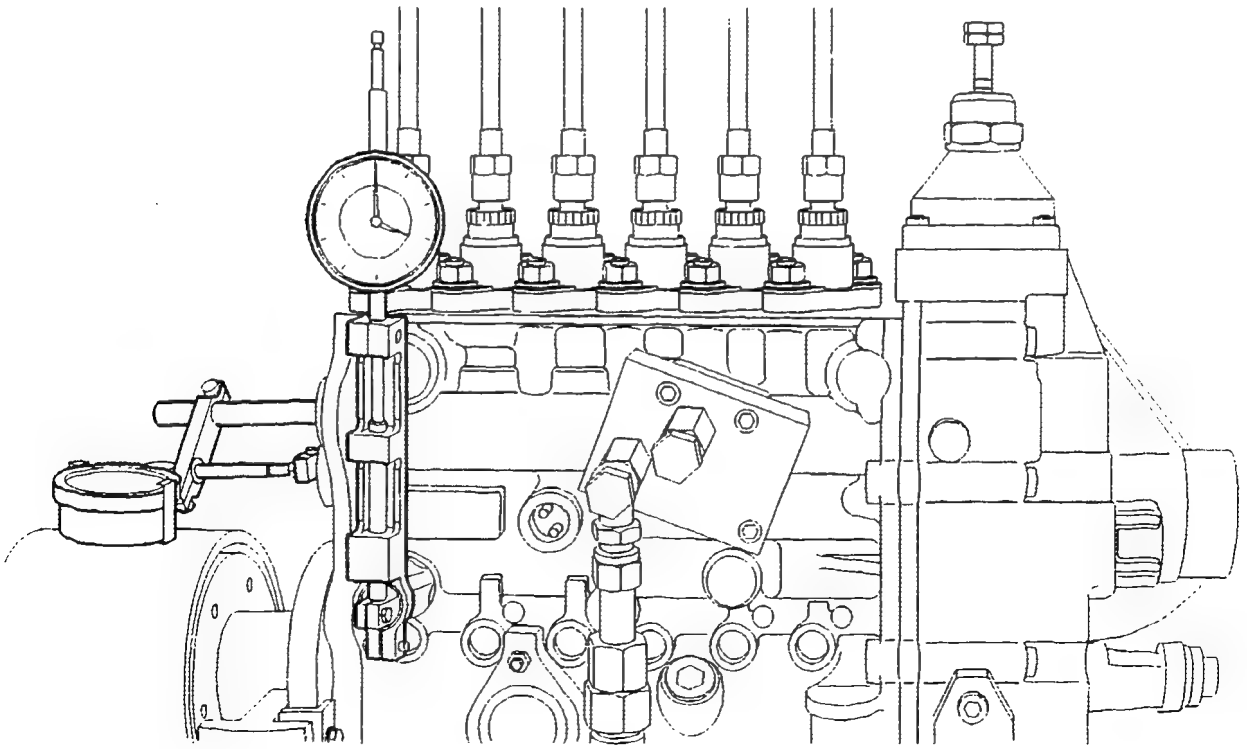
TEST AND ADJUSTMENT INSTRUCTIONS

Testing upper control-lever stop (MAX stop):

* Set camshaft/roller tappet at start-of-delivery adjustment barrel to BDC.
* Attach prestroke measuring device and set to 0.
* Set control rod to 10.5 mm CRT by adjusting current at regulator (precision adjustment by hand) and block at CRT measuring device. Switch regulator off again.

Continue: D01/1 Fig.: C28/2

KMK05488



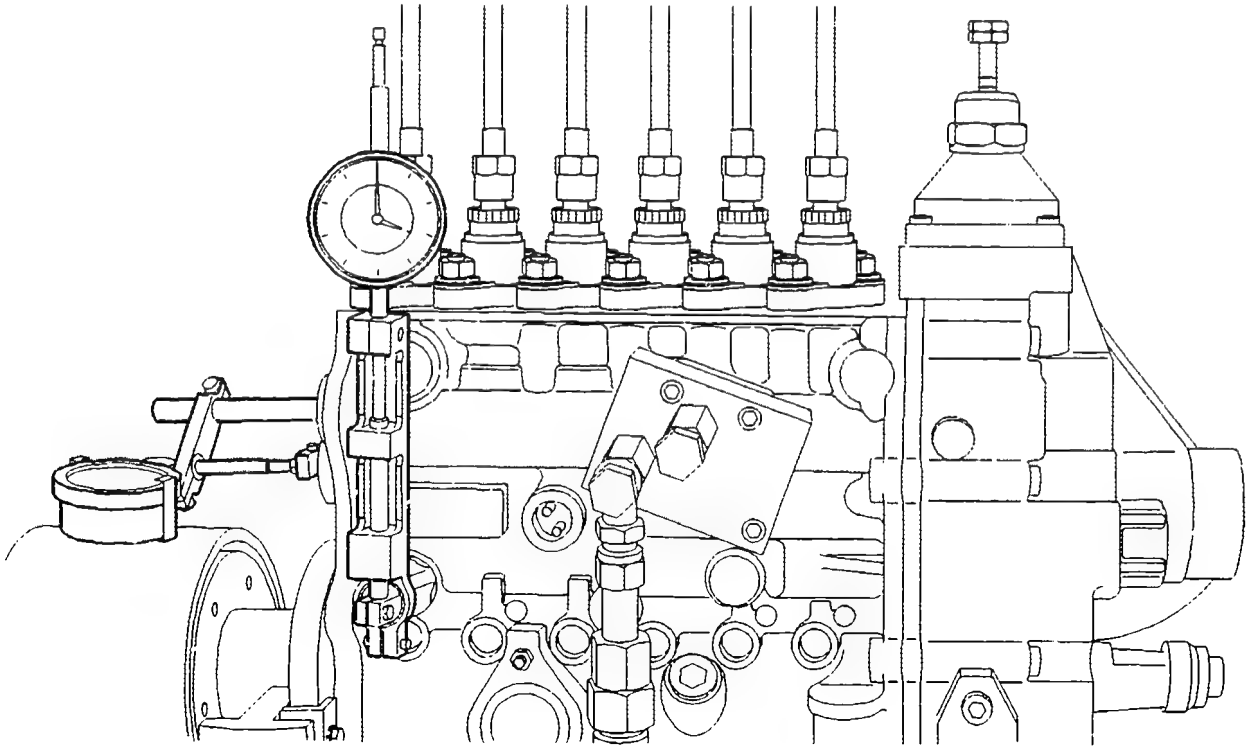
TEST AND ADJUSTMENT INSTRUCTIONS

Testing MAX stop:

* Completely screw back adjusting screw of measuring device 0 986 612 657 over prestroke solenoid (prestroke armature - rest position).
* Turn camshaft until start of delivery results (determine exactly) and establish resultant prestroke. Set value: "Start of delivery with prestroke MAX" as per test specification sheet +/- 0.05 mm
* Value outside tolerance: Readjust prestroke/start of delivery/stop. Refer to Coordinate: B17/1

Continue: D02/1 Fig.: D01/2

KMK05488



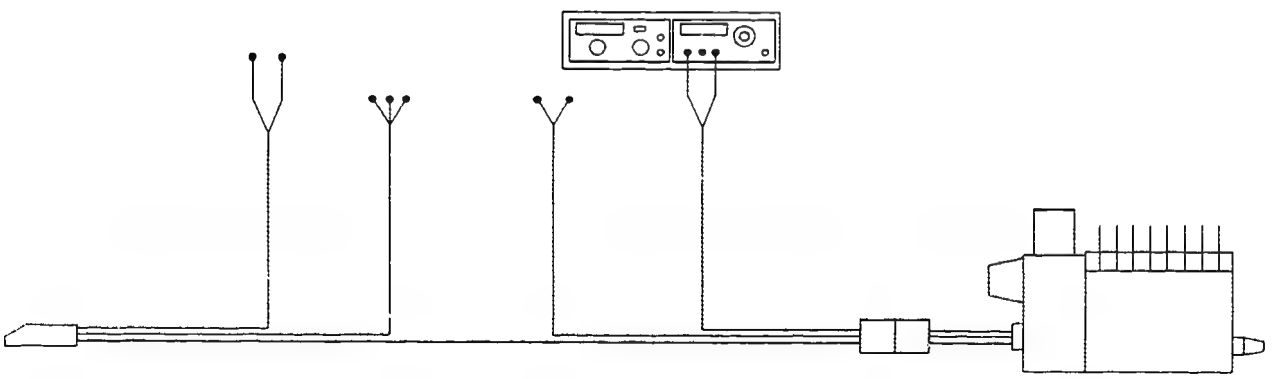
TEST AND ADJUSTMENT INSTRUCTIONS

Testing lower control-lever stop (MIN stop):

* Reset camshaft/roller tappet at start-of-delivery adjustment barrel to BDC.
* Connect actuation line for prestroke solenoid - two-core lead to positioner, plug green (+) and blue (-) - to regulator 12 V/ 15 A.

Continue: D03/1 Fig.: D02/2

KMK05582



TEST AND ADJUSTMENT INSTRUCTIONS

Testing MIN stop:

Note: Terminate following procedure in 1 minute due to self-heating of prestroke solenoid.

* Set current at regulator to 6...6.5 A - results in full armature deflection.
* Turn camshaft until start of delivery results (determine exactly) and measure resultant prestroke.
  Set value: "Start of delivery with prestroke MAX" as per test specification sheet minus 6.2 +/- 0.15 mm.
* Regulate current to 0.

Continue: D03/2

TEST AND ADJUSTMENT INSTRUCTIONS

Testing MIN/MAX stops:

If one or both values for the MIN/MAX stops is/are outside tolerance:
Fault in prestroke positioner or incorrect setting of stops; readjust prestroke/start of delivery/stops.
See Coordinate: B17/1

Continue: D04/1

TEST AND ADJUSTMENT INSTRUCTIONS

Adjusting flange at positioner housing (only on versions which feature such a flange):

The adjustment flange is provided with fastening slots for adjustment and is attached - depending on version - with two hexagon socket-head bolts or with one break-off screw and one such bolt.

Continue: D04/2

TEST AND ADJUSTMENT INSTRUCTIONS

Setting adjustment flange at positioner housing:

On setting, position of flange with respect to cam of disk cam is fixed using start-of-delivery blocking device 0 986 611 746.
As this cannot be visually tested with positioner housing closed, procedure to be adopted for checking is same as for adjustment.
To do so, loosen both fastening screws. Saw slot in head of break-off screw and loosen with screwdriver.

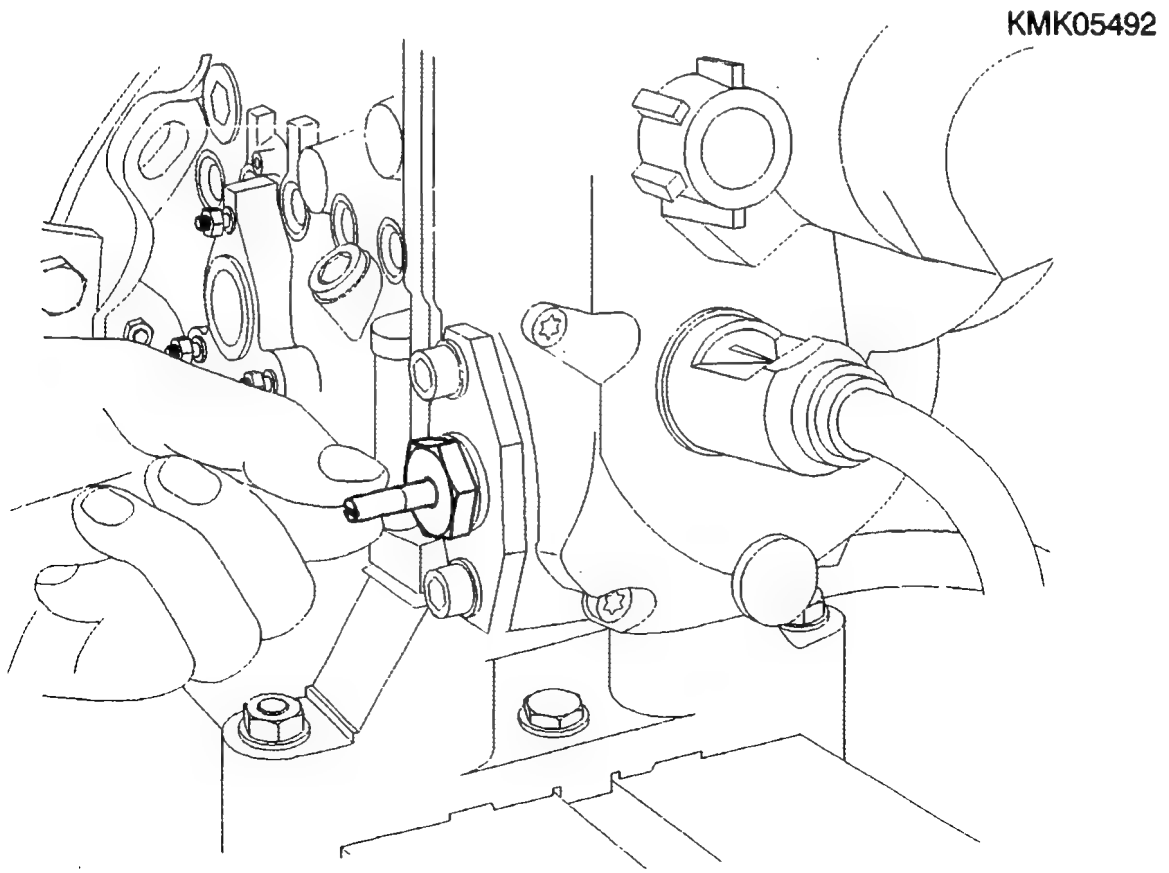
Continue: D05/1

TEST AND ADJUSTMENT INSTRUCTIONS

Setting adjustment flange at positioner housing:

* Adjust camshaft/roller tappet to customer-specific setting for disk cam (prestroke ... mm at start-of-delivery adjustment barrel).
* Screw out screw plug at adjustment flange. Insert blocking device 0 986 611 746 and screw in by hand. In doing so, shift flange such that cam of disk cam is felt to fully engage in blocking device notch.

Continue: D06/1 Fig.: D05/2

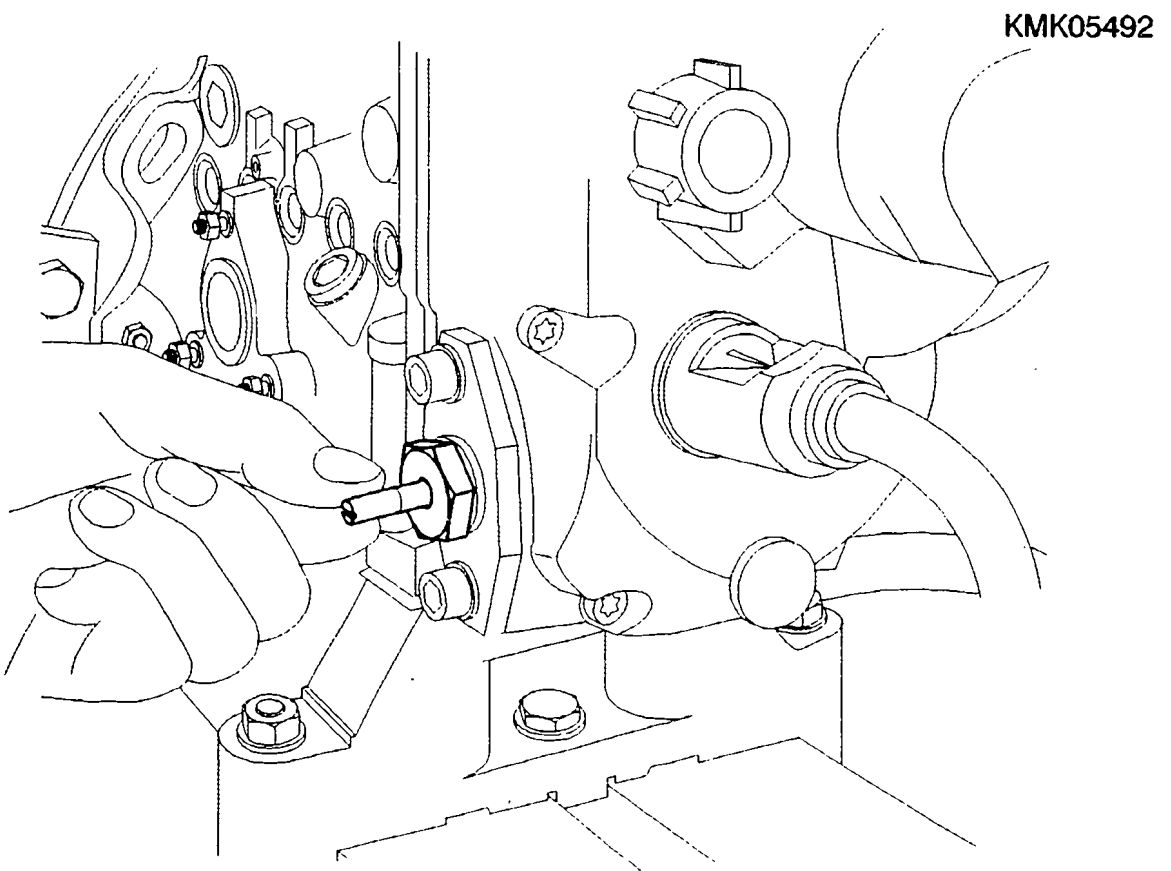


Setting adjustment flange at positioner housing:

Note: If the adjustment described previously cannot be made, the disk cam has been incorrectly positioned on assembly.

* Tighten flange fastening screws with blocking device inserted to 7...9 Nm. Replace break-off screw with new one and tighten until head breaks off.
* Remove blocking device and screw in screw plug.

Continue: D07/1 Fig.: D06/2



TEST AND ADJUSTMENT INSTRUCTIONS

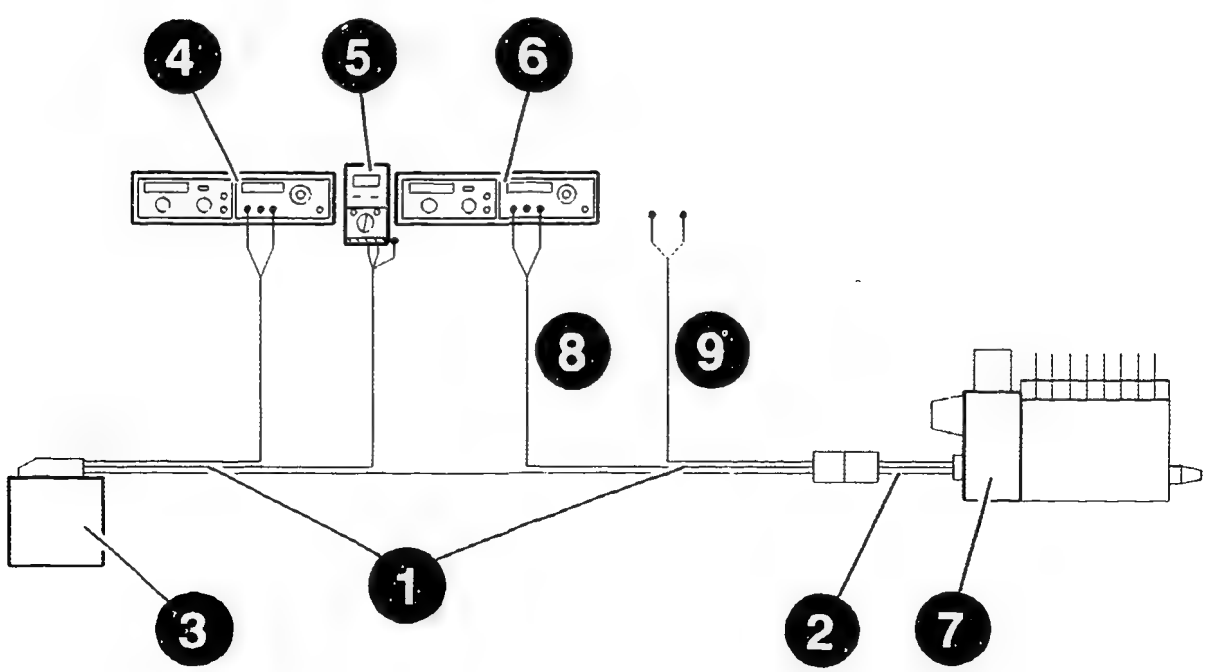
Preparation for testing positioner and injected quantity:

Connect test and supply components with line set as per connection diagram and legend with notes:

1 = Universal test lead 0 986 610 102 (KDEP-P 400/2).
2 = Adapter lead for positioner connection. Choose in accordance with positioner design.
3 = Test control unit (universal evaluation circuit) 0 986 610 101 (KDEP-P 400/1).

Continue: D08/1 Fig.: D07/2

KMK05583



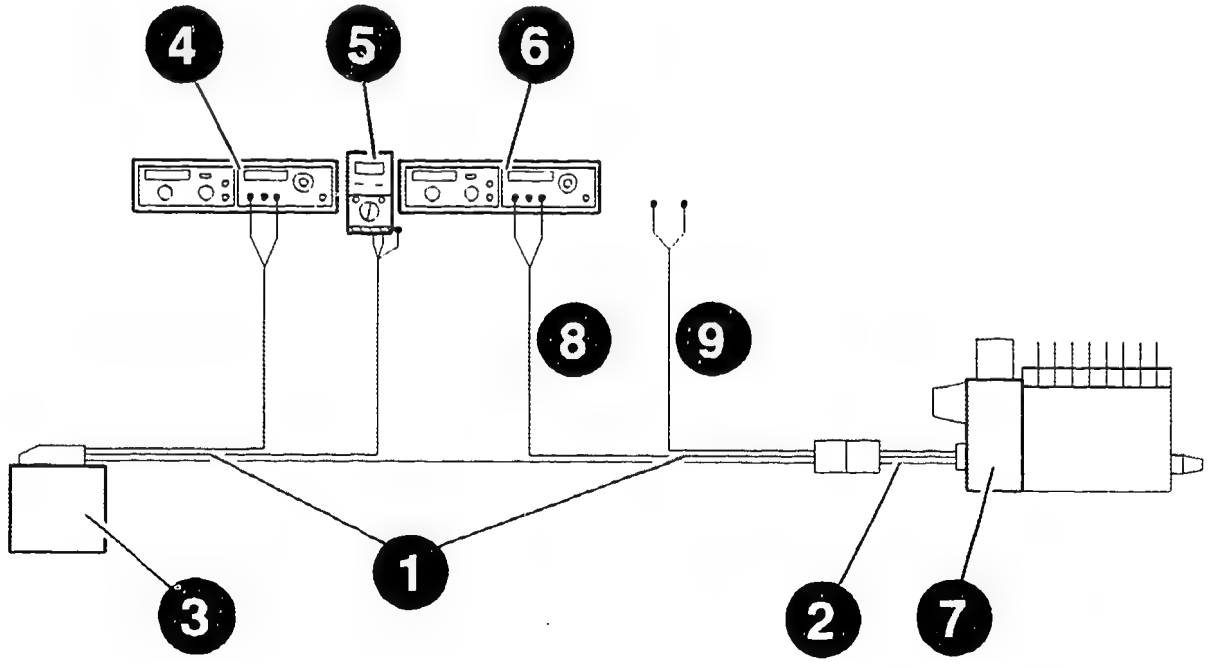
TEST AND ADJUSTMENT INSTRUCTIONS

Preparation for testing positioner and injected quantity:

4 = Regulator 12 V/3 A
Connector: red (+),
black (-).
5 = Digital voltmeter 0...5 V.
Connector:
red = reference voltage (U/ref),
green = output voltage (U/act),
blue = measurement ground.

Continue: D09/1 Fig.: D08/2

KMK05583



TEST AND ADJUSTMENT INSTRUCTIONS

Preparation for testing positioner and injected quantity:

6 = Regulator 12 V/15 A (adjustable).
Connector: red (+), black (-) for injected-quantity solenoid
Connector: green (+), blue (-) for prestroke solenoid

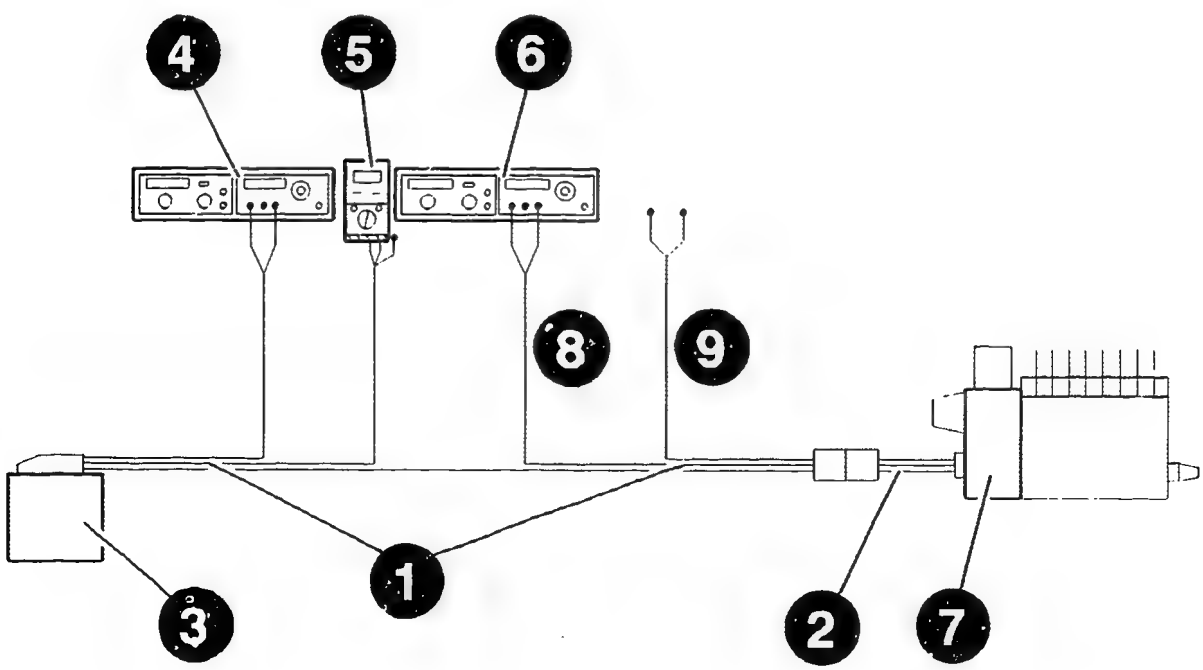
7 = Positioner
Connection: adapter lead in line with positioner version

8 = Connection, injected-quantity solenoid
red/black

9 = Connection, prestroke solenoid
green/blue

Continue: D10/1 Fig.: D09/2

KMK05583



TEST AND ADJUSTMENT INSTRUCTIONS

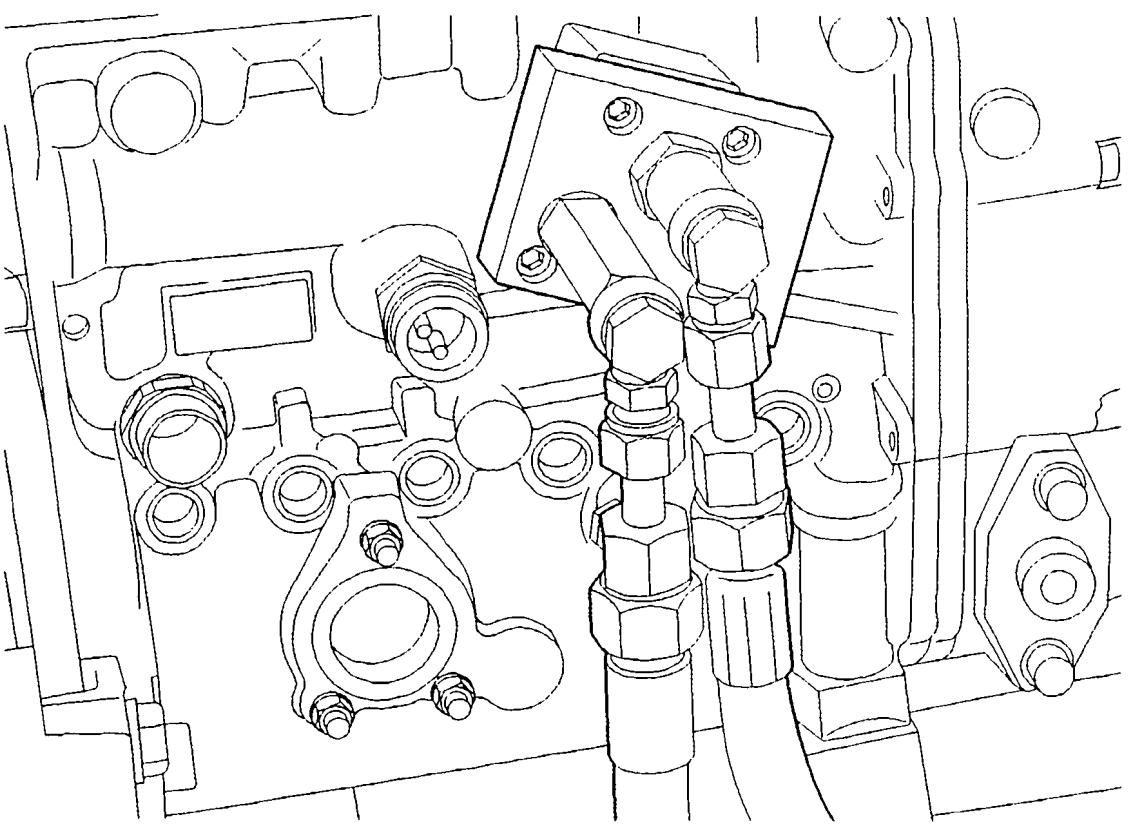
Preparation for testing positioner and injected quantity:

Calibrating-oil connections:

Connect inlet and return via adapter 0 986 612 653 to attachment flange for EHAB or ELAB.
Connection for injected-quantity measurements:
Inlet at lower connection, overflow valve and return at upper connection.
Refer to test-specification sheet for prescribed check valve.

Continue: D11/1 Fig.: D10/2

KMK05584



TESTING AND ADJUSTMENT INSTRUCTIONS

Preparation for checking positioner and injected quantity:

Electrical test equipment:

Switch on regulator for supplying test control unit (evaluation circuit).
Setting: 13.0...14.0 V, approx. 2 A.

Continue: D11/2

TESTING AND ADJUSTMENT INSTRUCTIONS

Preparation for checking positioner and injected quantity:
Voltmeter:
* Connection for testing U/ref (reference voltage of test control unit/ supply voltage for RPS): red (+), blue (-).
  Desired reading: 4.99...5.01 V.
  Incorrect value: tester defective.
* Connection for all other tests (U/act): green (+), blue (-).

Note: U/act represents the voltage calculated by the tester from the RPS signal and is thus a measure of the control rod travel.

Continue: D12/1

Preparatory work prior to positioner and injected-quantity testing:

Switch on regulator for positioner.
Current setting: Initially 0 A.

Note: The control rod can be moved as desired by way of the current setting on the regulator; this is not possible by hand on account of the strong return spring of the control rod. The continuous application of current for maximum control rod travel is to be limited to a maximum of 1 minute on account of the heating-up of the servo magnet.

Continue: D13/1

TEST AND ADJUSTMENT INSTRUCTIONS

Warm up unit:
Switch on regulator for positioner.
Set approx. 10 mm control-rod travel by way of current setting and block with control-rod-travel measuring device. Do not switch off regulator.
Switch on test bench, set inlet pressure as per test-specification sheet. Pay attention to direction of rotation and warm up unit at n = 600 min-1. At the same time, warm up calibrating oil to inlet temperature as specified by test-specification sheet. Then release control-rod blocking mechanism, set 0 A current and shut down fuel-injection pump.

Continue: D13/2

TEST AND ADJUSTMENT INSTRUCTIONS

Set control-rod-travel measuring device and check shutoff position:
* Specify maximum control-rod travel (start position) by way of current setting and adjust control-rod-travel dial indicator to precisely 21 mm. This basic setting applies to all other tests.
* Return current to 0 A and check shutoff position.
  Refer to test-specification sheet for set value.
* Repeat procedure several times and check whether same result is obtained in each case.

Maximum permitted deviation: 0.1 mm.
Ok?

Yes: D15/1 No: D14/1

* If results differ (deviation greater than 0.1 mm):
  Control rod or injected-quantity adjusting magnet sticking.

* Wrong shutoff position:
  Dimension "X" (spindle in armature) incorrectly calibrated.

* Both situations necessitate removal of positioner and possibly repair of positioner/injection pump.

Continue: D15/1

TEST AND ADJUSTMENT INSTRUCTIONS

Testing RPS adjustment
("Setting" as per test-specification sheet):

* Check whether dial indicator of CRT measuring device is set to precisely 21 mm with maximum CRT.
* By adjusting current, set control rod such that U/act exactly corresponds to value as per test-specification sheet. (Perform fine adjustment by hand at control rod).
* CRT must now likewise correspond to value as per test-specification sheet (check value "P").

OK?

Yes: D19/1 No: D15/2

TEST AND ADJUSTMENT INSTRUCTIONS

Adjusting RPS:

The RPS fastening screw (clamping screw) is accessible from outside through a hole, which is secured against tampering with a plastic seal.
In order to be able to adjust RPS, plastic seal is to be drilled out and destroyed with 12 mm bit. Refer to next Coordinate.

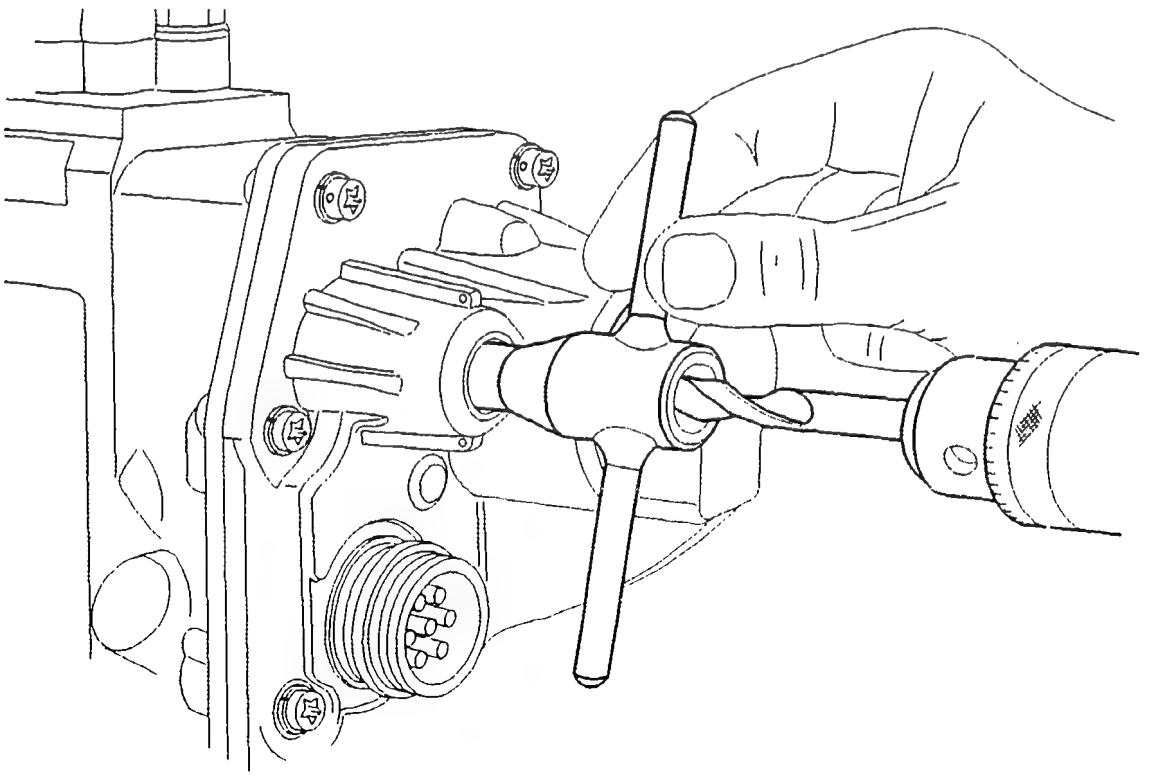
Continue: D16/1

Removing plastic seal from RPS adjustment bore:

Hold seal with pin-type socket wrench 0 986 611 459 (KDEP 2990) to stop it turning and drill out until it is pierced (retainers break off).
Attention: Drill at low speed and do not use excessive force. After penetration, pull back drill immediately so that tip cannot catch and damage rack position sensor.

Continue: D17/1 Fig.: D16/2

KMK004480



Adjusting RPS:

* Set control-rod travel exactly in accordance with "setting" as per test-specification sheet (mean value of tolerance range, e.g. 13.0 mm) and block at control-rod-travel measuring device.

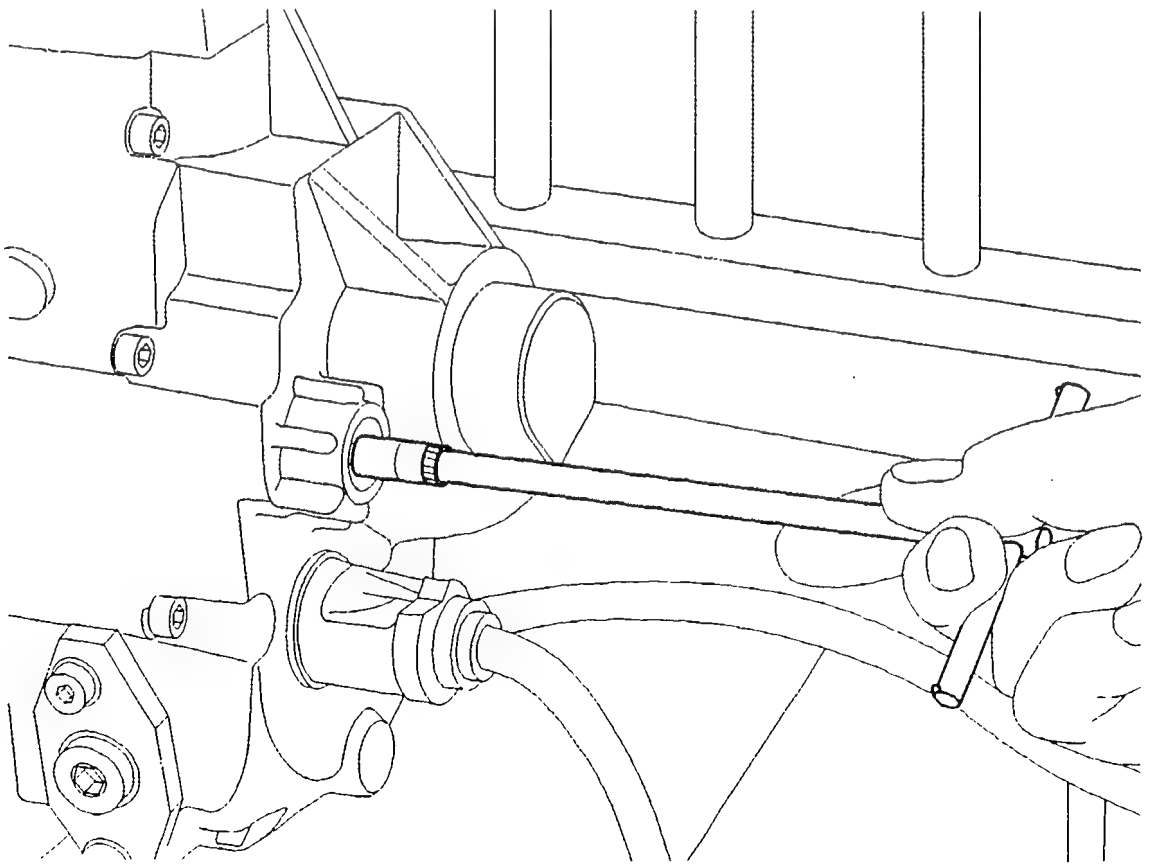
Continue: D18/1

TESTING AND ADJUSTMENT INSTRUCTIONS

* Loosen clamping screw for RPS (5 mm hexagon socket) and move rack position sensor with Allen wrench such that U/act precisely corresponds to "setting" as per test specification sheet.
* Tighten clamping screw in this position to tightening torque of 15...18 Nm.
  Note: Tighten uniformly and smoothly, and adhere precisely to tightening torque, so as to avoid seizure of tapered clamping screw in RPS clamping sleeve.
* Check adjustment again and correct if necessary.

Continue: D19/1 Fig.: D18/2

KMK05585



TESTING AND ADJUSTMENT INSTRUCTIONS

Checking of RPS "check value" as per test specification sheet:

Set U/act to "check value". The control rod travel must then lie within the stated tolerance band.

OK?

Yes: D20/1 No: D19/2

TEST AND ADJUSTMENT INSTRUCTIONS

If check value is outside tolerance despite correct adjustment of "setting", the rack position sensor is defective, i.e. diassembly, repair and assembly of positioner, as well as repetition of all tests.

Continue: D20/1

Adjusting RPS:

After RPS has been adjusted, fit new plastic seal with O-ring in bore.

Note: The service seal is red, as opposed to the black factory one. There is also a blue seal, which is used by the engine manufacturer if he effects correction of the RPS adjustment.

Continue: D21/1

Delivery testing and adjustment

* Applies to test points V1 and L1 as per test-specification sheet.
* Set control-rod position for injected quantity values by way of precise adjustment of U/act value as per test specification sheet.
* As regards control-lever pump, additionally pay attention for individual injected-quantity measurement points to certain prestroke positioner settings indicated in test specification sheet as prestroke solenoid travel.

Continue: D22/1

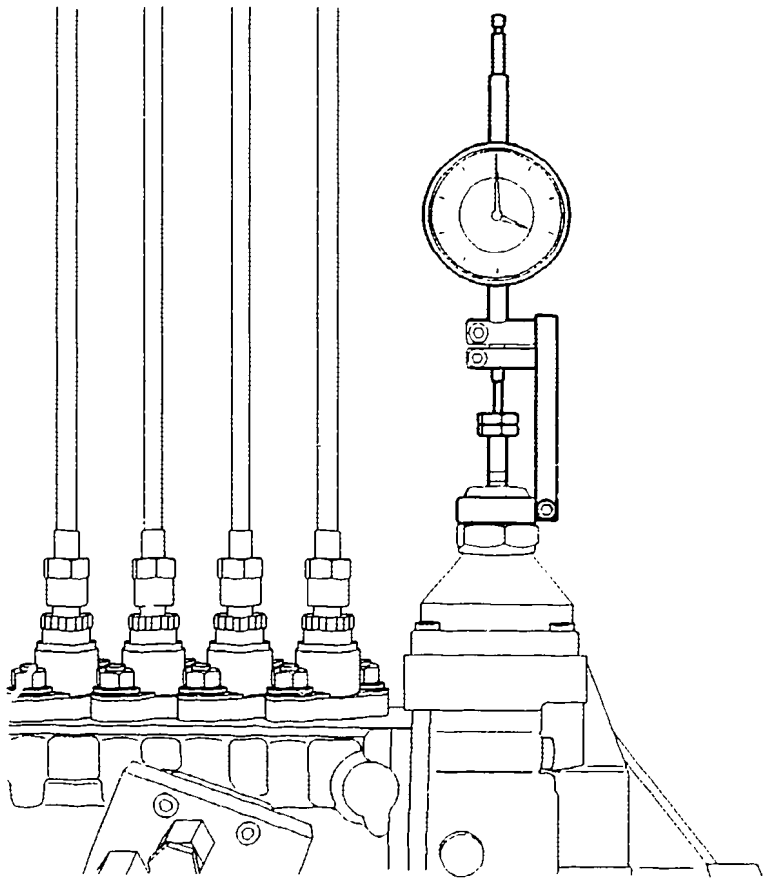
TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing and adjustment:

Attaching travel measuring device for prestroke solenoid:

* Unscrew housing cover over prestroke solenoid and replace it with test cover 0 986 912 676.
* Screw travel measuring device with adjusting screw 0 986 612 657 into cover.
* Attach dial-indicator holder 1 688 130 030 to travel measuring device.
* Insert dial indicator 1 687 233 012 with feeler (commercially available, length approx. 80 mm, thread M 3) into dial-indicator holder.

Continue: D23/1 Fig.: D22/2



KMK05502

TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing and adjustment:

Adjusting travel measuring device for prestroke solenoid:

* Turn back adjusting screw as far as it will go (armature rest position).
* Pretension dial indicator and set to 14 mm (definition value for all positioner versions).
* Data in test-specification sheet regarding solenoid travel are absolute values.
  Example: Indicated stroke 8 mm: Starting from 14 mm, set 8 mm, i.e. position armature 6 mm lower with adjusting screw.

Continue: D24/1

TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing and adjustment:

Test point "V 1" as per test specification sheet (setting point):

* Drive pump at stated speed. By way of current adjustment and fine adjustment by hand precisely set U/act value for V1 and block at CRT measuring device.
* Use adjusting screw to set prestroke solenoid to stated travel value.

Continued on next Coordinate.

Continue: D24/2

TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing and adjustment:

* Perform injected-quantity measurement V1. Values must coincide with data in test-specification sheet.

Note: Determination of the actual deliveries is the same as for all Bosch in-line pumps. The relevant criteria are summarized in the following:

Continue: D25/1

TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing and adjustment:

* With graduate-type test benches, the first quantity measurement is designed to moisten the graduates, which are then to be emptied again. Run-out time 30 seconds.
* Determination of delivery with blue line on back of graduate, which forms two points which face one another as a result of refraction on the surface of the liquid.

Continue: D25/2

TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing and adjustment:

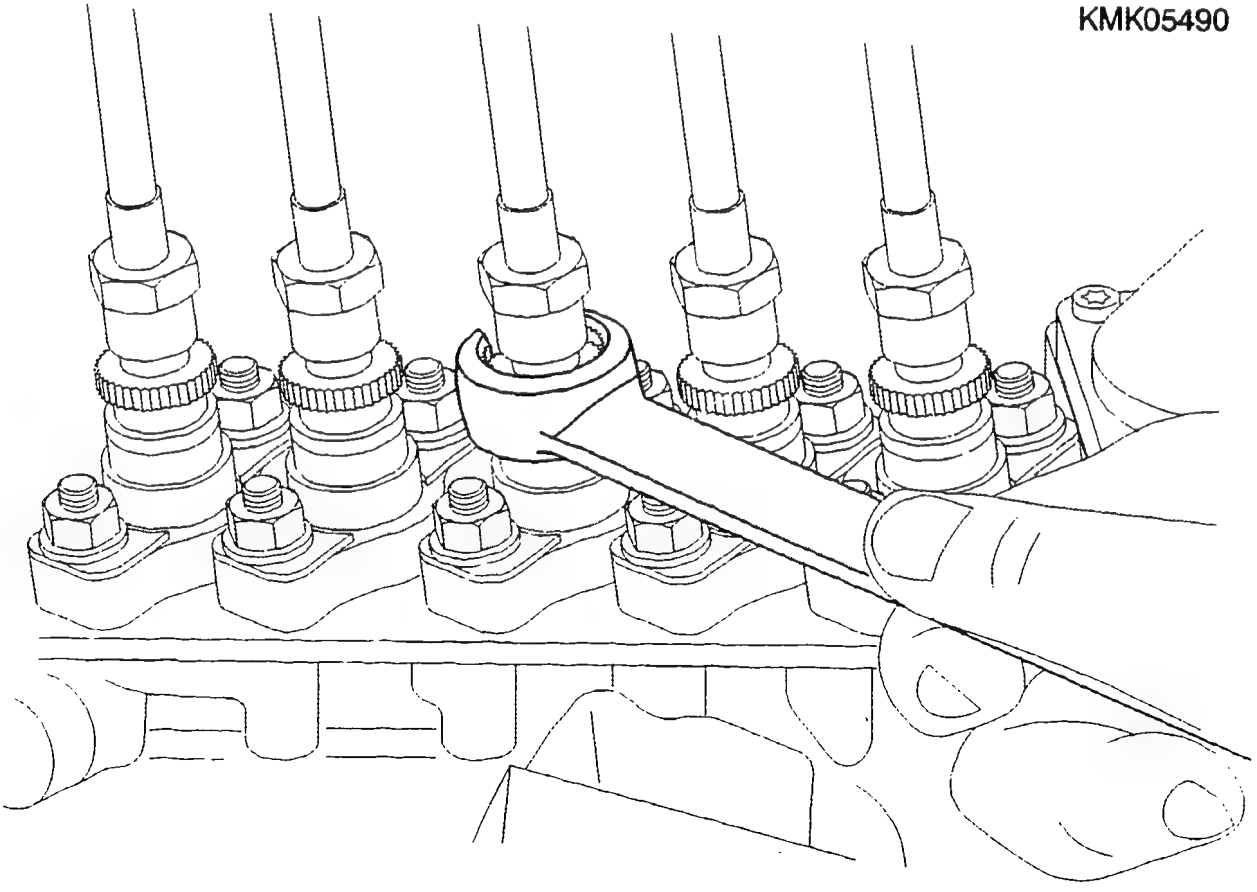
* The delivery given in the test specifications is the average value for all individual quantities determined.
* The stated scatter designates the maximum permissible difference in quantity between the smallest and largest individual quantity.
* Check values are marked with "P" in the test-specification sheet; values without "P" apply to adjustment.

Continue: D26/1

Delivery testing and adjustment:
Quantity adjustment as standard for P-pumps:

* Shut down injection pump.
* Loosen hexagon nuts of appropriate assembly flanges and turn assemblies accordingly with box spanner 0 986 611 452 in area of flange slots.
* Tighten hexagon nuts of flanges to 50...55 Nm.
* Repeat measurement and correction until all values are within tolerances given in test-specification sheet.

Continue: D27/1 Fig.: D26/2



TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing and adjustment:

Test point "L1":
Then perform test point L1.
Procedure for quantity measurement and determination of values as for V1, however note the following:

* Main test criterion for L1 is injected-quantity value as per test-specification sheet. This value must be attained within the stated U/act tolerance range.
  Procedure as described on next Coordinate.

Continue: D27/2

TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing and adjustment:

Test point L1:

* Initially set control-rod position without observance of U/act value such that L1 quantity value as per test-specification sheet is attained, i.e. if necessary the correct value is to be "sought" by measuring quantity several times.
  The U/act value must then be within the tolerance as per the test specification sheet.

Continue: D28/1

Delivery testing and adjustment:
Test point L1:
Possible causes if L1 values not attained:

* U/act outside tolerance with quantity value correct:
  + RPS defective.
  + Worn injection pump; possibility of incorrect assemblies or delivery valves.
* Excessive scatter:
  + With L1 scatter can be optimized, however only without exceeding tolerance for V1.
  + Worn injection pump.

Continue: E01/1

TEST AND ADJUSTMENT INSTRUCTIONS

Functional testing of oil pump
(if fitted):

Test prerequisite: Positioner sealed, RPS adjustment hole sealed, control rod in shutoff position (current 0 A).

Test with suitable vacuum gauge (e.g. Bosch vacuum gauge 1 688 130 032 - special accessory for injection-pump test benches - or commercially available) with hose and rubber plug suitable for start-of-delivery bore in adjustment flange.

Continue: E01/2

TEST AND ADJUSTMENT INSTRUCTIONS

Functional testing of oil pump:

Note: Versions with no adjustment flange, but with an oil pump, feature a bore with screw plug in the top side area of the positioner for pouring in oil and as measurement bore for connection of vacuum gauge.

Continue: E02/1

TEST AND ADJUSTMENT INSTRUCTIONS

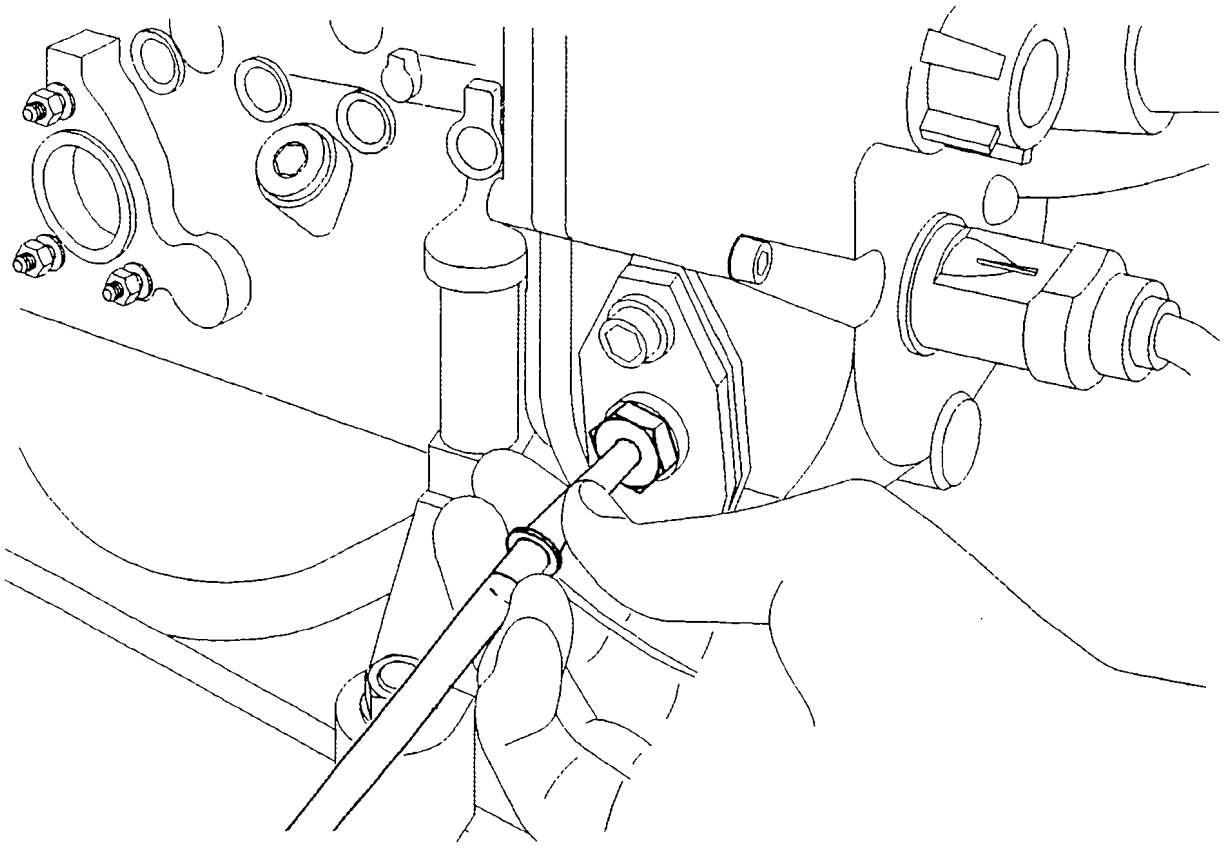
Functional testing of oil pump:

Screw out screw plug in adjustment flange/top of positioner and pour oil SAE 20 W 20 through tapped hole into positioner as far as overflow/maximum of 100 mL.

Drive pump at n = 1000 1/min and immediately position rubber plug with hose of vacuum gauge against measurement bore and press on firmly.
Determine vacuum value after 30 seconds.
Set value: min. 25 mbar.
Is set value attained?

Yes: E04/1 No: E03/1 Fig.: E02/2

KMK05491



TEST AND ADJUSTMENT INSTRUCTIONS

Functional testing of oil pump:

Possible causes of trouble in the event of inadequate oil-pump performance:

* Positioner leaking. Eliminate leakage.

* Oil pump defective/worn.

Both situations involve disassembly of positioner. Procedure as per repair instructions for control-lever pump.

Continue: E04/1

TEST AND ADJUSTMENT INSTRUCTIONS

Testing fuel-temperature sensor (if fitted):

* Test prerequisite: calibrating-oil temperature 38...42 Grad C.

* Measure resistance at both pins of temperature sensor.

  Set value: 0.95...1.4 kOhm.

* Replace defective fuel-temperature sensor and tighten to torque of 30...35 Nm.

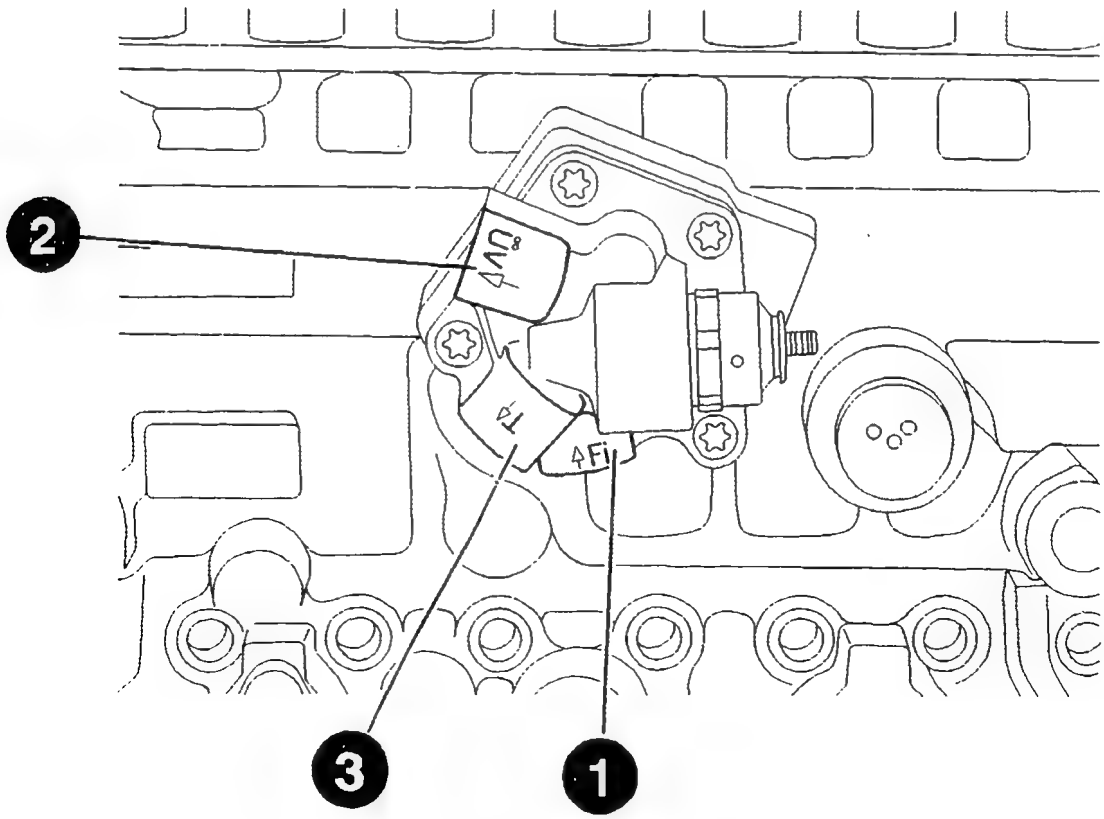
Continue: E05/1

ELAB functional test (assemblies with ELAB only):

* Unscrew calibrating-oil inlet and return line at adapter.
* Disassemble adapter at pump housing and mount ELAB (complete). Coat fastening screws with Loctite 242 and tighten to 7...9 Nm.
* Calibrating-oil connections (example; connections differ depending on ELAB housing):
  1 = Inlet
  2 = Overflow valve and return
  3 = Sealed

Continue: E06/1 Fig.: E05/2

KMK05586



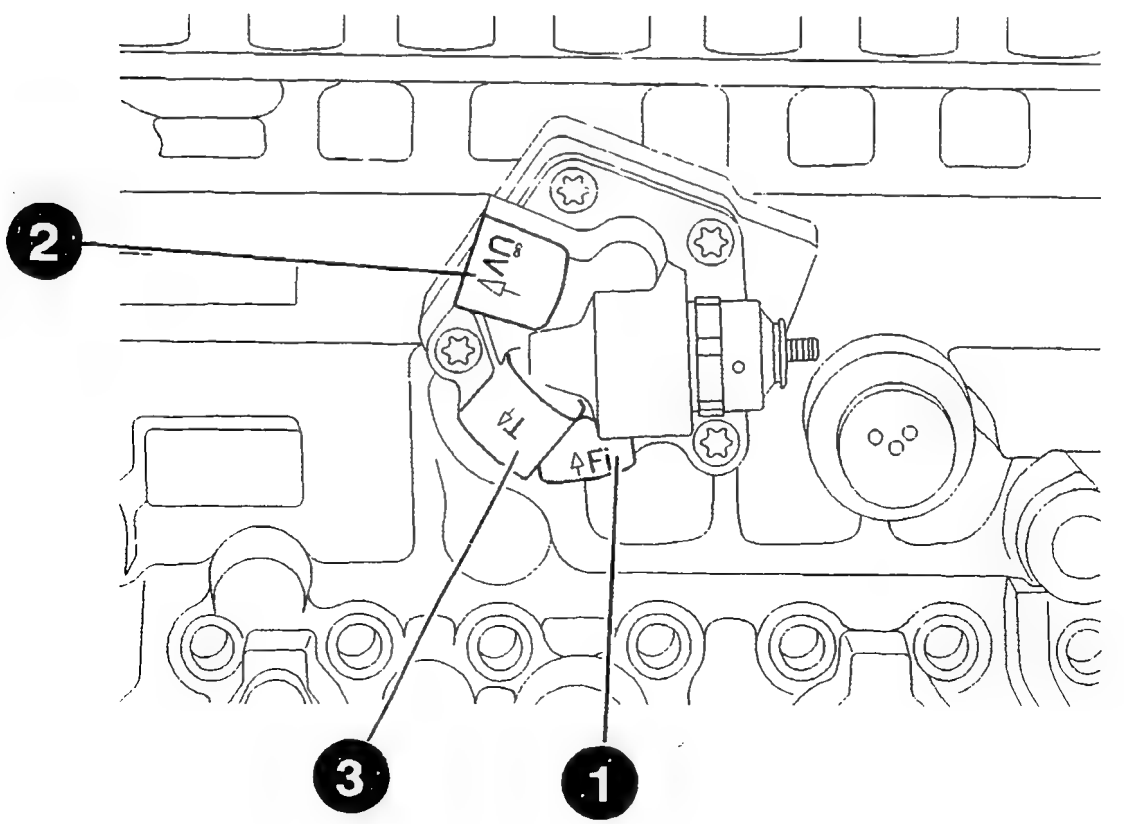
TEST AND ADJUSTMENT INSTRUCTIONS

ELAB functional test:

* Connect power supply to ELAB solenoid valve. Observe correct voltage 12 or 24 V.
* Set speed to: 1000 1/min
* Set control-rod position to U/act: 3.100 V
* After bleeding pump: Disconnect power supply at ELAB solenoid valve and observe quantity delivered at calibrating nozzle holder.
* After a measurement period of 10 seconds delivery at all barrels must be zero.

Continue: E07/1 Fig.: E06/2

KMK05586



TEST AND ADJUSTMENT INSTRUCTIONS

ELAB functional test:

If zero delivery is not obtained after prescribed measurement time: Replace ELAB and repeat functional test.

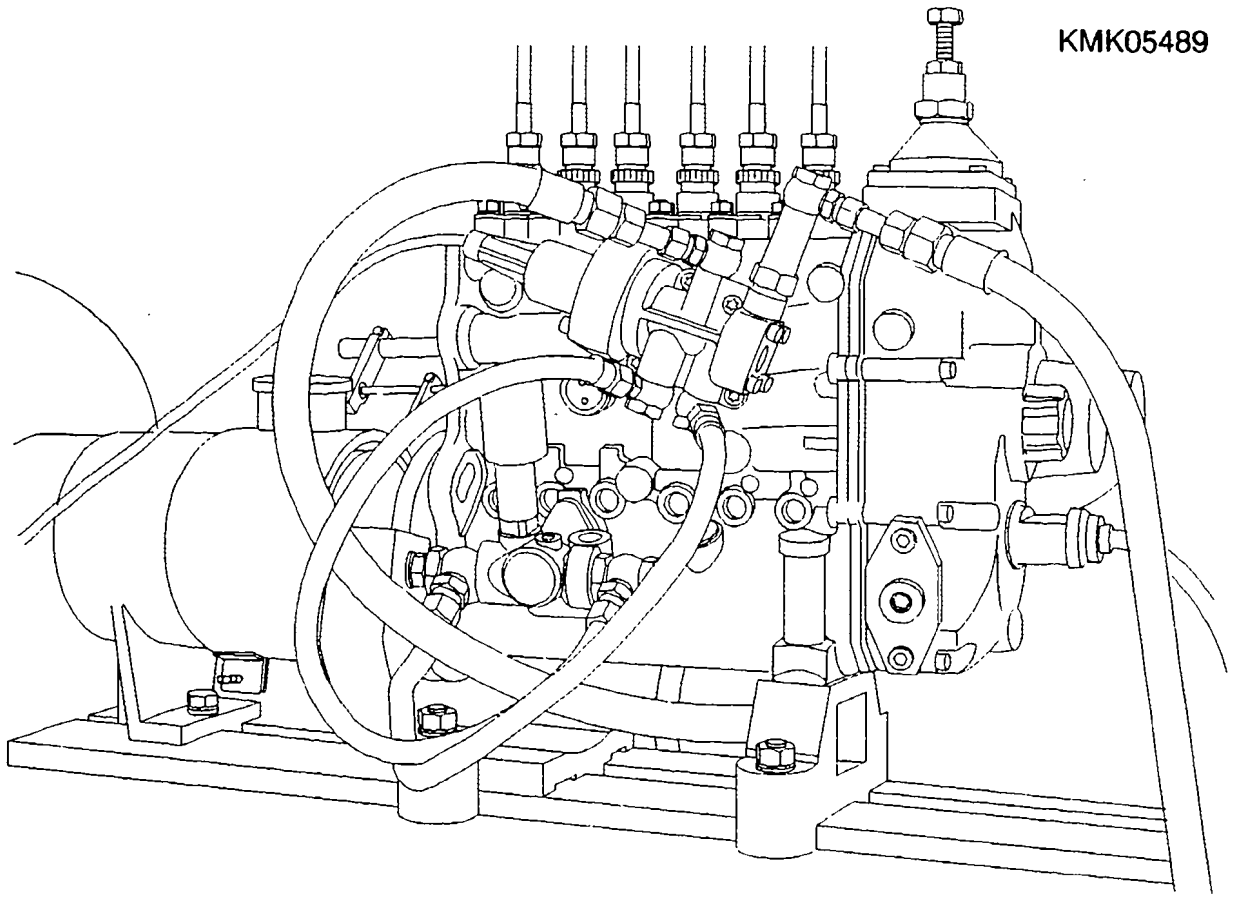
Continue: E08/1

TEST AND ADJUSTMENT INSTRUCTIONS

EHAB functional test (assemblies with EHAB only):

* Unscrew calibrating-oil inlet and return line at adapter.
* Disassemble adapter at pump housing and install EHAB (complete). Coat fastening screws with Loctite 242 and tighten to 7...9 Nm.
* Install fuel supply pump forming part of assembly with new seal and tighten nuts to 7...9 Nm.

Continue: E09/1 Fig.: E08/2



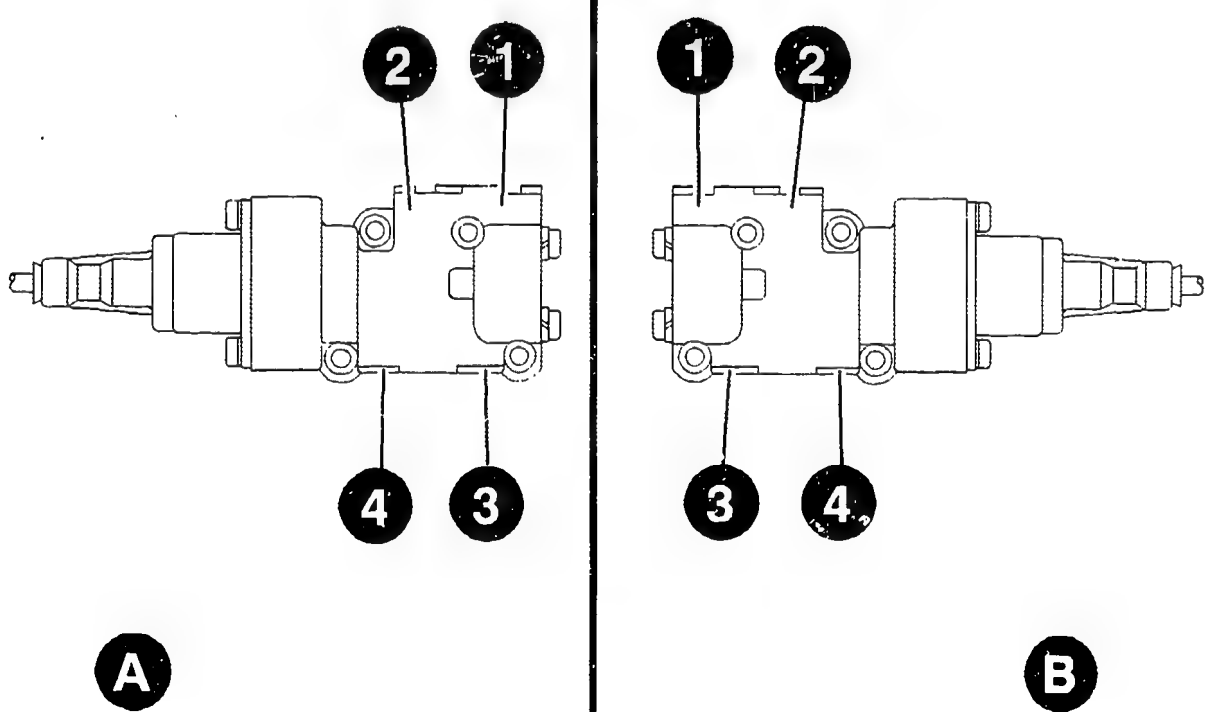
EHAB functional test:

* Calibrating-oil connections: Connections as on engine. Supply pump - EHAB connections with hose set (2 lines) 1 680 711 002.
* Connections to EHAB:
  A = Solenoid, left
  B = Solenoid, right

  1 = Overflow valve and test-bench return
  2 = Test-bench inlet
  3 = To supply pump - intake end
  4 = To supply pump - delivery end

Continue: E10/1 Fig.: E09/2

KMK05587

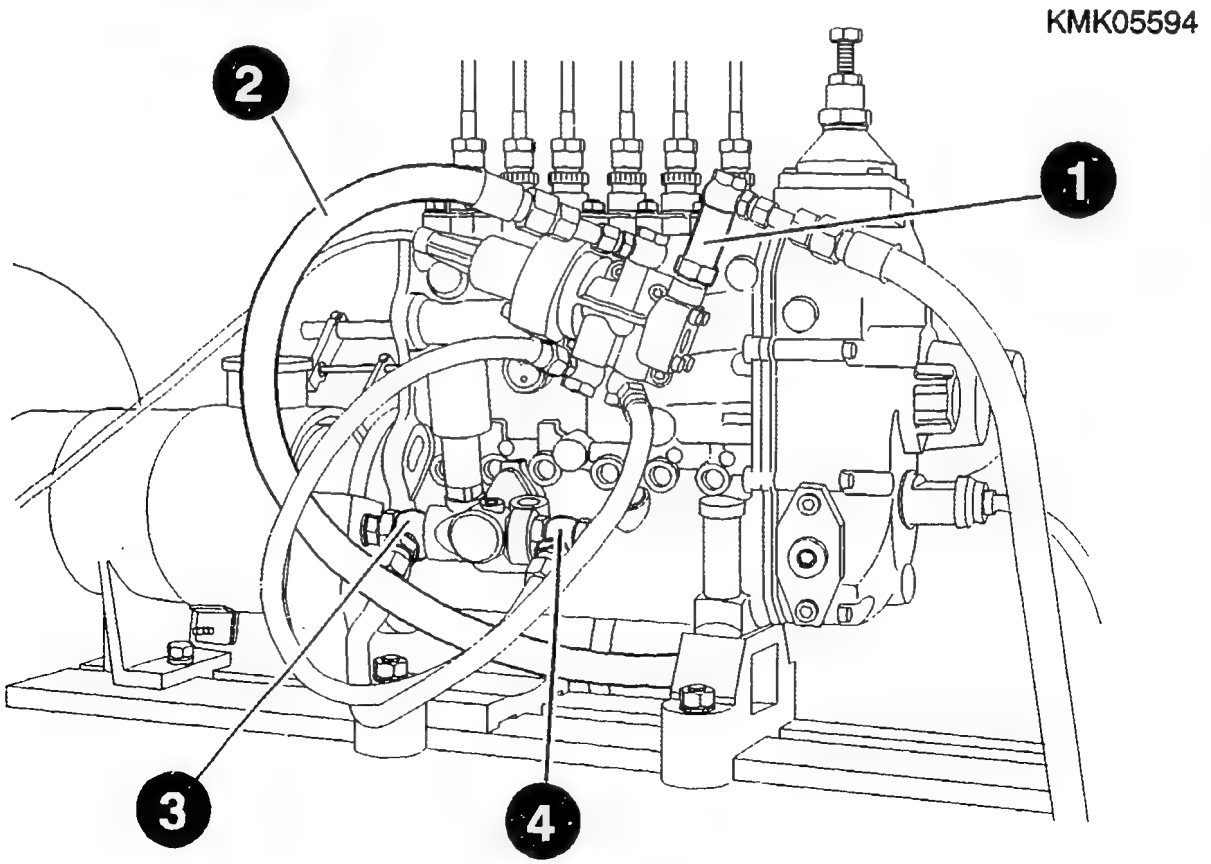


EHAB functional test:

* Fig.: Complete tubing for EHAB with solenoid attachment, left

1 = Overflow valve with test-bench return
2 = Test-bench inlet
3 = Supply pump - intake end
4 = Supply pump - delivery end

Continue: E11/1 Fig.: E10/2



TEST AND ADJUSTMENT INSTRUCTIONS

EHAB functional test:

Voltage supply, EHAB:

* Voltage supply 12 or 24 V at both pins with individual test leads, e.g. from Bosch test-lead set 1 687 011 208.
  Choice of the correct connections is governed by the plug design.
  Voltage supply via appropriate test-bench jacks.

Continue: E12/1

TEST AND ADJUSTMENT INSTRUCTIONS

EHAB functional test:
Test procedure:
* Connect power supply to EHAB solenoid. Observe correct voltage 12 or 24 V.
* Switch on test bench.
  Set inlet pressure to: 0 bar
* Set speed to: 1000 l/min
* Set control-rod position to U/act: 2.500 V
* Set prestroke solenoid travel to: 14 mm (rest position)

Continue: E12/2

TEST AND ADJUSTMENT INSTRUCTIONS

EHAB functional test:

Test procedure (continued):
* After bleeding pump:
  Disconnect power supply at EHAB solenoid and observe quantity delivered at calibrating nozzle holder.
* After a measurement time of 1 second delivery at all barrels must be zero.

OK?

Yes: E14/1 No: E13/1

TEST AND ADJUSTMENT INSTRUCTIONS

EHAB functional test:

Possible causes of trouble if switching to zero delivery does not take place:

* EHAB defective.

  Repair EHAB (see repair instructions - control-lever pump) or replace and repeat test.

Continue: E13/2

TEST AND ADJUSTMENT INSTRUCTIONS

EHAB functional test:
Possible cause of trouble if switching to zero delivery is too slow (sequence reflects probability):

* Overflow valve leaking.
  There must be no overflow valve leakage in direction opposite to flow direction.
* EHAB defective. Repair EHAB (see repair instructions - control-lever pump) or replace EHAB.
* Supply pump defective. Replace.
* Repeat test.

Continue: E14/1

TEST AND ADJUSTMENT INSTRUCTIONS

Concluding operations:

Removing assembly from test bench and completion for delivery:

* If necessary, drain surplus lubricating oil out of camshaft chamber.
* If still to be done, insert plastic seal with new seal ring in RPS adjustment bore.
* If envisaged, attach plastic seals for positioner fastening screws (see replacement parts list).

Continue: E14/2

TEST AND ADJUSTMENT INSTRUCTIONS

Concluding operations:

* Screw control-rod closure cap onto pump drive end.
* Fit/complete original drive coupling.
* Plug all fuel connections.
* On assemblies with oil pump pour in oil SAE 20 W 20 via hole in adjustment flange/in top of positioner housing as far as overflow/ max. 100 ml.

Continue: E15/1

Concluding operations:

* Wipe calibrating oil off assembly and apply paint seals:
  - One barrel-and-valve assembly fastening nut each
  - Control-rod screw plug
  - ELAB/EHAB fastening screw
  - Positioner fastening screw on versions with no plastic seal
  - Cap and lock nut, control-rod guide
  - Fastening screw, drive-end bearing
  - Housing cover, prestroke solenoid

Continue: N27/1

CHECKING INSTRUCTIONS

Table of contents:

Continue: F01/2

CHECKING INSTRUCTIONS

Table of contents:

Continue: F02/1

CHECKING INSTRUCTIONS

General:

The following CHECKING INSTRUCTIONS were compiled specially for initial checking of control-lever pumps with RE positioner, e.g. for warranty checks. In other words, these instructions are to be used if the assembly is not to be dismantled in any way prior to testing (exception: removal of ELAB/EHAB and supply pump). The instructions differ from the TEST AND REPAIR INSTRUCTIONS in the first part in terms of the items listed on the following Coordinate.

Continue: F02/2

CHECKING INSTRUCTIONS

General (continued):

The individual test sections in the following CHECKING INSTRUCTIONS are the same as in the TEST AND ADJUSTMENT INSTRUCTIONS in the first part, however the sequence is different. Moreover, all operations required for adjustment of a repaired assembly do not apply. The sequence of the test sections is to be exactly adhered to when performing the check.

Continue: F03/1

CHECKING INSTRUCTIONS

General (continued):

So as not to extend the overall instructions unnecessarily, the following CHECKING INSTRUCTIONS do not give a detailed description of general sections such as tool/tester list, installation of assembly on test bench and attachment/connection of test equipment. These are merely mentioned with reference to the first part of the overall instructions.

Continue: F03/2

CHECKING INSTRUCTIONS

General:

Special note:
If within the framework of checking an assembly on the basis of these instructions certain values or functions are incorrect and rectification is possible without disassembly, this is described at the appropriate juncture.
In the event of faults necessitating disassembly work, testing is to be terminated, repairs performed and adjustment carried out in line with the TEST AND ADJUSTMENT INSTRUCTIONS.

Continue: F04/1

CHECKING INSTRUCTIONS

Preparation for testing:

* Installation of injection pump on test bench:
  See Coordinate: B05/1

* Calibrating-oil connections:
  See Coordinate: B11/1

* Lubricating-oil first fill:
  See Coordinate: B12/1

* Attaching CRT measuring device:
  See Coordinate: B13/1

Continue: F04/2

CHECKING INSTRUCTIONS

Preparation for testing:

* Adjusting CRT measuring device:
  See Coordinate: D13/2

* Attaching prestroke measuring device:
  See Coordinate: B15/1

* Connecting test and supply components with line set:
  See Coordinate: D07/1

Continue: F05/1

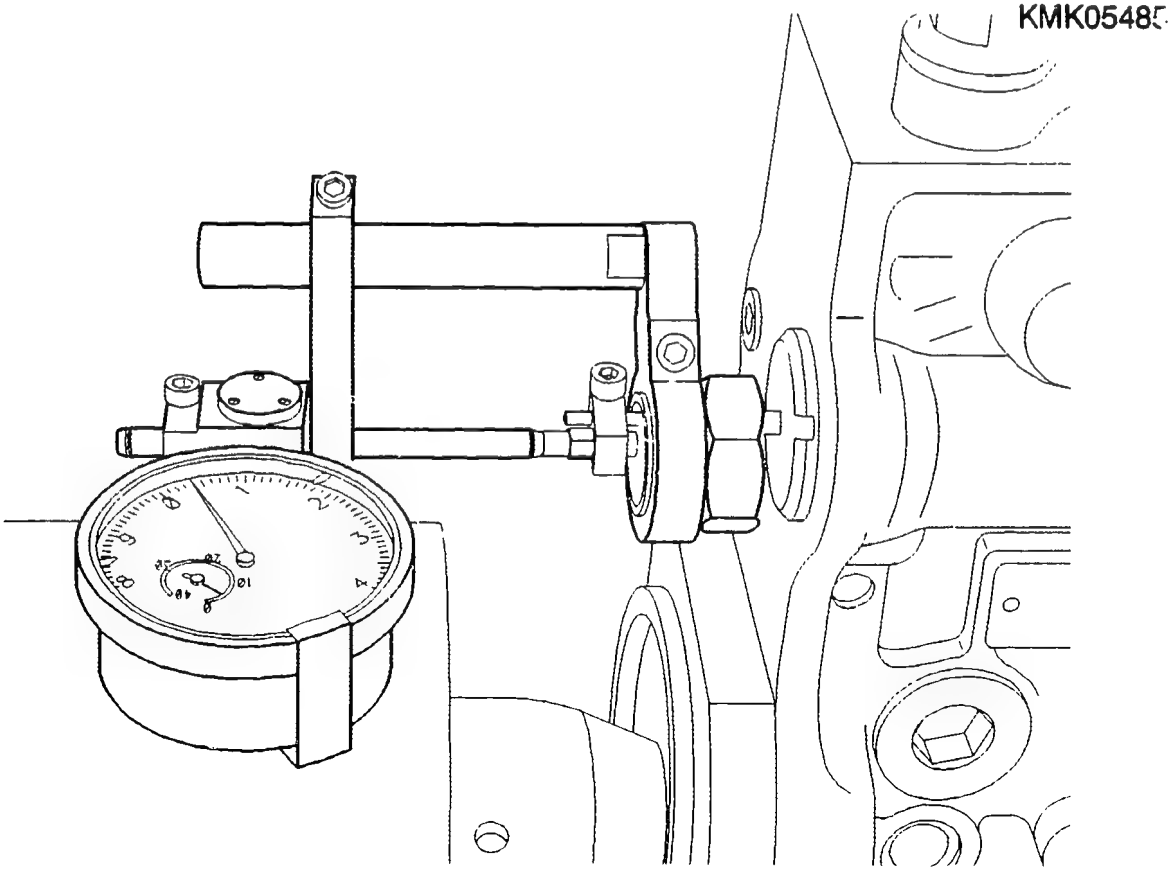
CHECKING INSTRUCTIONS

Preparation for testing:

* Remove supply pump and ELAB/EHAB (depending on equipment). Connect calibrating-oil inlet.

* Unscrew cap nut for control rod on pump drive end.
  Attach CRT measuring device.

Continue: F06/1 Fig.: F05/2



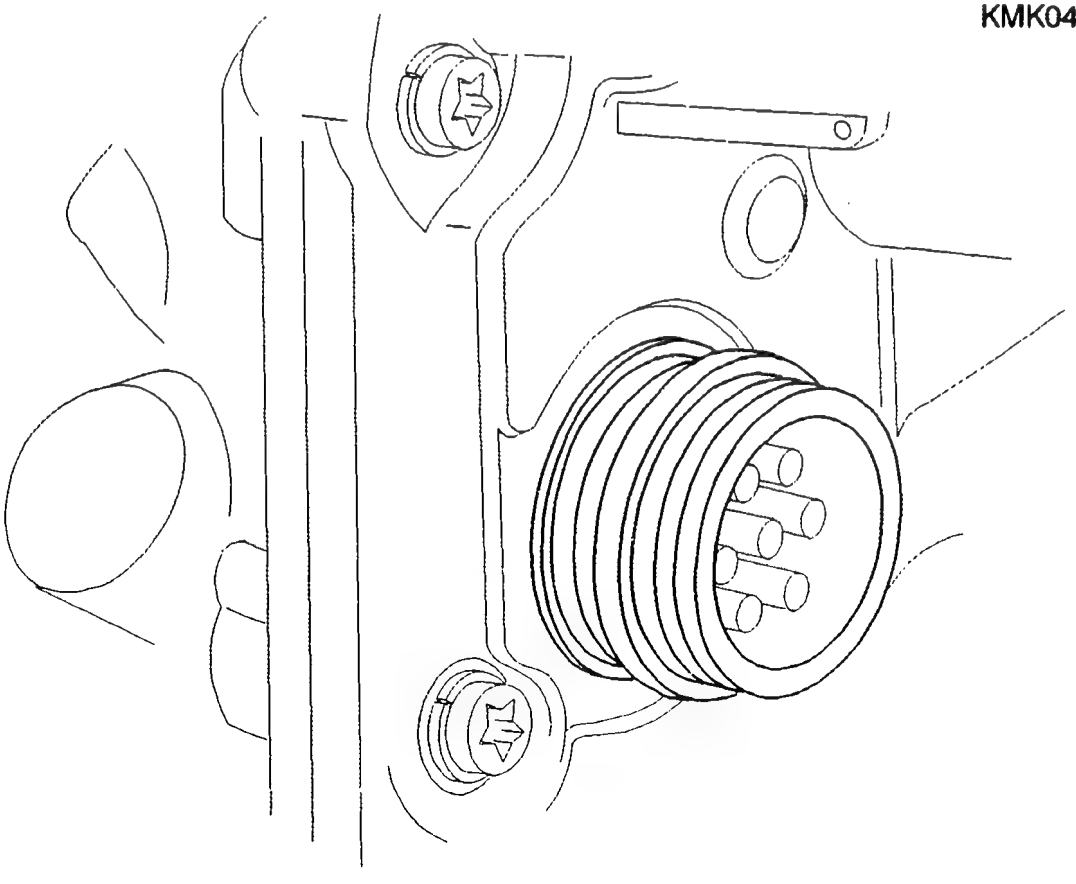
CHECKING INSTRUCTIONS

Initial testing:

Housing-fixed round screw connection: Check thread for damage (caused for example by not fitting cap nut straight). Check contact pins for corrosion and erosion (e.g. on account of loose connector). Do not mechanically clean contact pins, as this damages surface coating. Slightly damaged thread can be reworked. In the event of severe damage repair positioner in line with repair instructions.

Continue F07/1 Fig.: F06/2

KMK04476



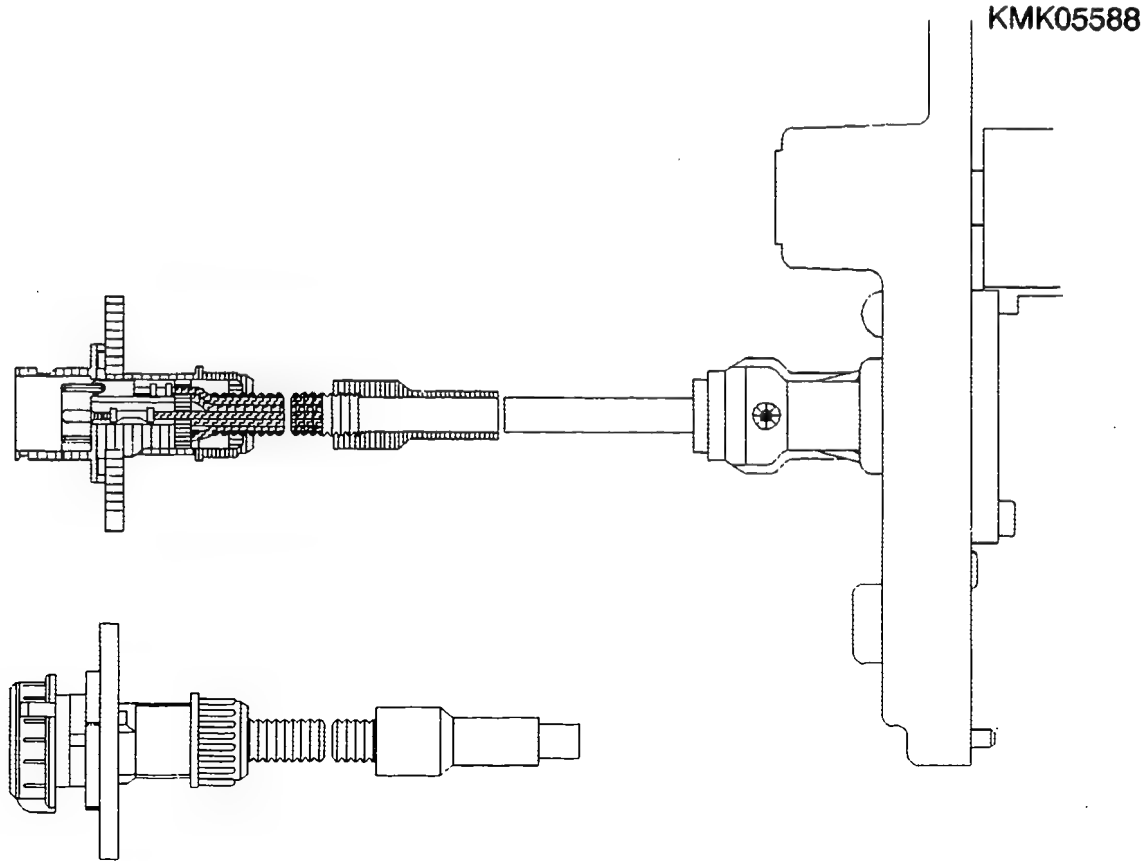
CHECKING INSTRUCTIONS

Initial testing:

On positioners with cable bushing and overhung plug (e.g. MAN assembly with Schlemmer plug) examine plug and lead for mechanical damage and contacts for corrosion/erosion. Repair positioner if necessary.

Fig.: Example: Schlemmer plug.

Continue: F08/1 Fig.: F07/2



CHECKING INSTRUCTIONS

Initial testing:

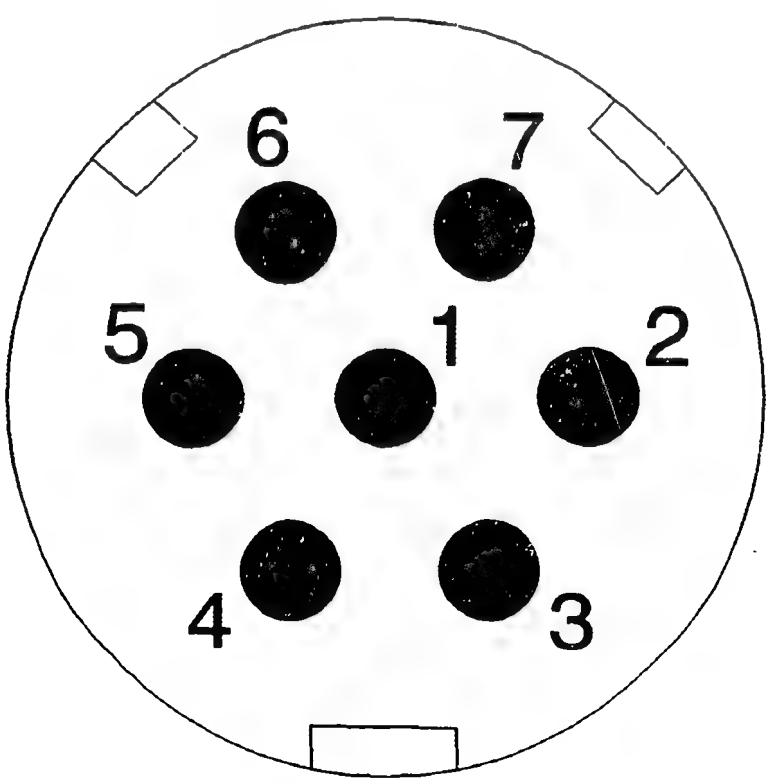
Resistance measurements at housing-fixed round screw connection, pin:

1-6 (RPS coil 1)	17...23 Ohm
6-5 (RPS coil 2)	17...23 Ohm
1-5 (RPS total)	34...46 Ohm
2-7 (Adj. magnet, qty.)	0.55...0.90 Ohm
3-4 (Prestroke sol.)	1.10...1.55 Ohm

Check for open circuit, short to ground and mutual contact short circuit.
Repair positioner if necessary.

Continue: F09/1 Fig.: F08/2

KMK01023



CHECKING INSTRUCTIONS

Initial testing:

Resistance measurements at contacts of overhung Schlemmer plug:

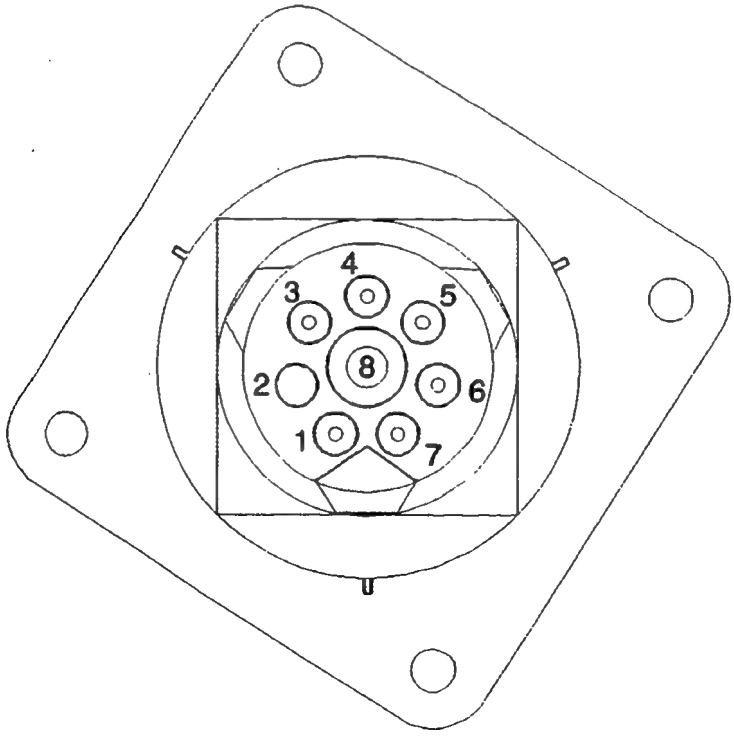
1-6 (RPS coil 1)	17...23 Ohm
5-6 (RPS coil 2)	17...23 Ohm
1-5 (RPS total)	34...46 Ohm
7-8 (Adj. magnet, qty.)	0.55...0.90 Ohm
3-4 (Prestroke sol.)	1.10...0.90 Ohm

2 = not used

Test for open circuit, short to ground and mutual contact/lead short circuit. Repair positioner if necessary.

Continue: F10/1 Fig.: F09/2

KMK05589



CHECKING INSTRUCTIONS

Initial testing:

* Fuel-temperature sensor (if fitted):
  Resistance value at calibrating-oil temperature
  38...42 Grad C: 950...1400 Ohm
* ELAB internal resistance:
  12 V: 9.8...11.4 Ohm
  24 V: 42...48 Ohm
* EHAB internal resistance:
  12 V: 9.5...12 Ohm
  24 V: 36...46 Ohm

Replace defective parts, repair EHAB if necessary.

Continue: F11/1

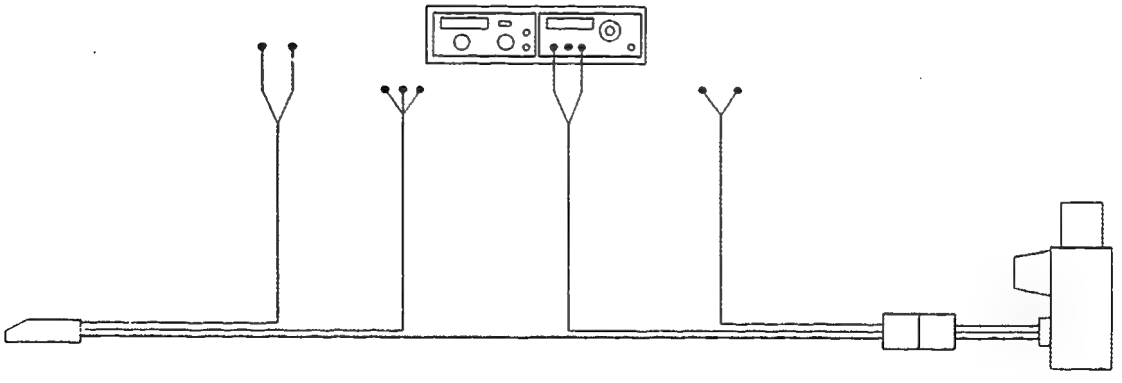
CHECKING INSTRUCTIONS

CRT measuring device adjustment:

* Connect version-specific adapter lead 0 986 610 ... and universal test lead 0 986 610 102 to positioner.
* Connect lead to positioner, red (+) - black (-) to regulator 12 V/15 A.
* Set current such that control rod goes to maximum CRT.
* Set CRT measuring device to precisely 21 mm.
  Duration of procedure max. 1 minute.

Continue: F12/1 Fig.: F11/2

KMK05581



CHECKING INSTRUCTIONS

Testing shutoff position of control rod:

* Switch off regulator and determine shutoff position of control rod. See test-specification sheet for set value.
* Repeat procedure several times and check whether result is always the same.
* Wrong shutoff position or differing results: Stiffness in pump or positioner or dimension "X" incorrectly calibrated. Terminate testing and repair assembly.

Continue: F13/1

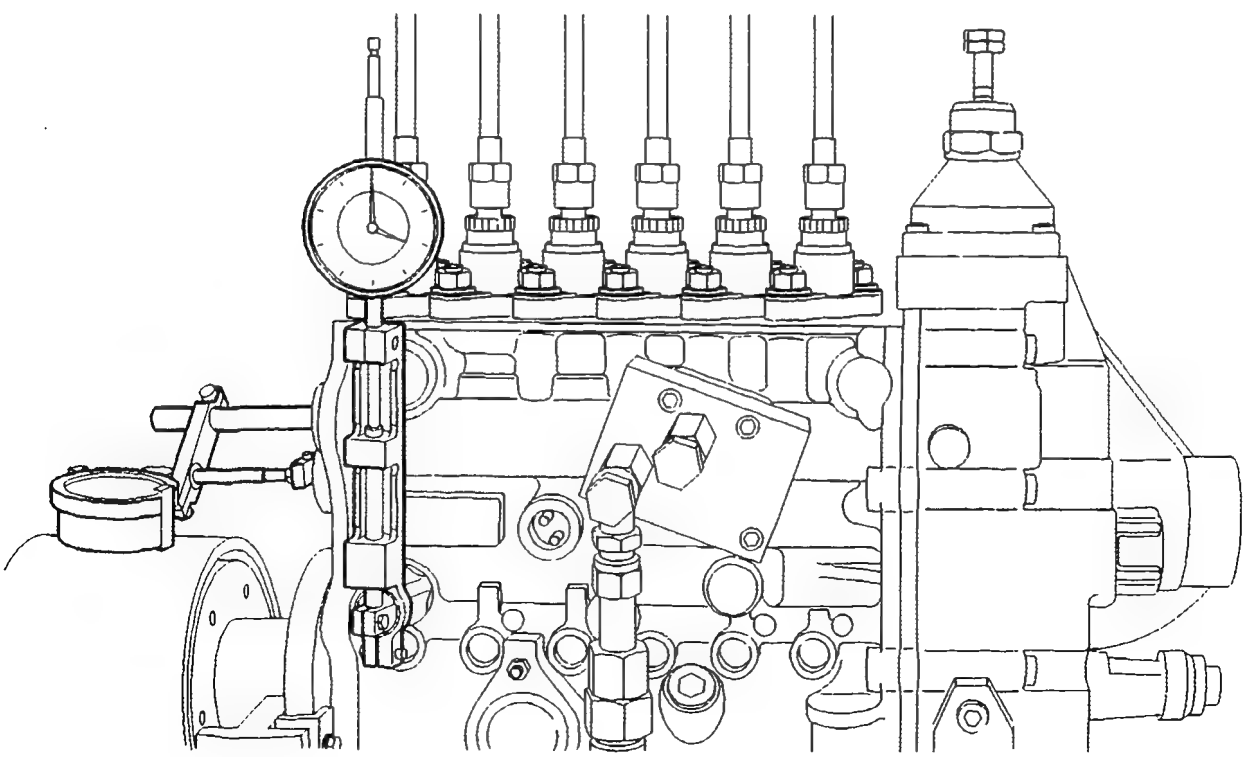
CHECKING INSTRUCTIONS

Testing internal control-lever stop for prestroke shaft (MAX stop):

* Set camshaft/roller tappet at start-of-delivery adjustment barrel to BDC.
* Attach prestroke measuring device and set to 0.
* Set control rod to 10.5 mm CRT by adjusting current at regulator (precision adjustment by hand) and block at CRT measuring device. Switch regulator off again.

Continue: F14/1 Fig.: F13/2

KMK05488



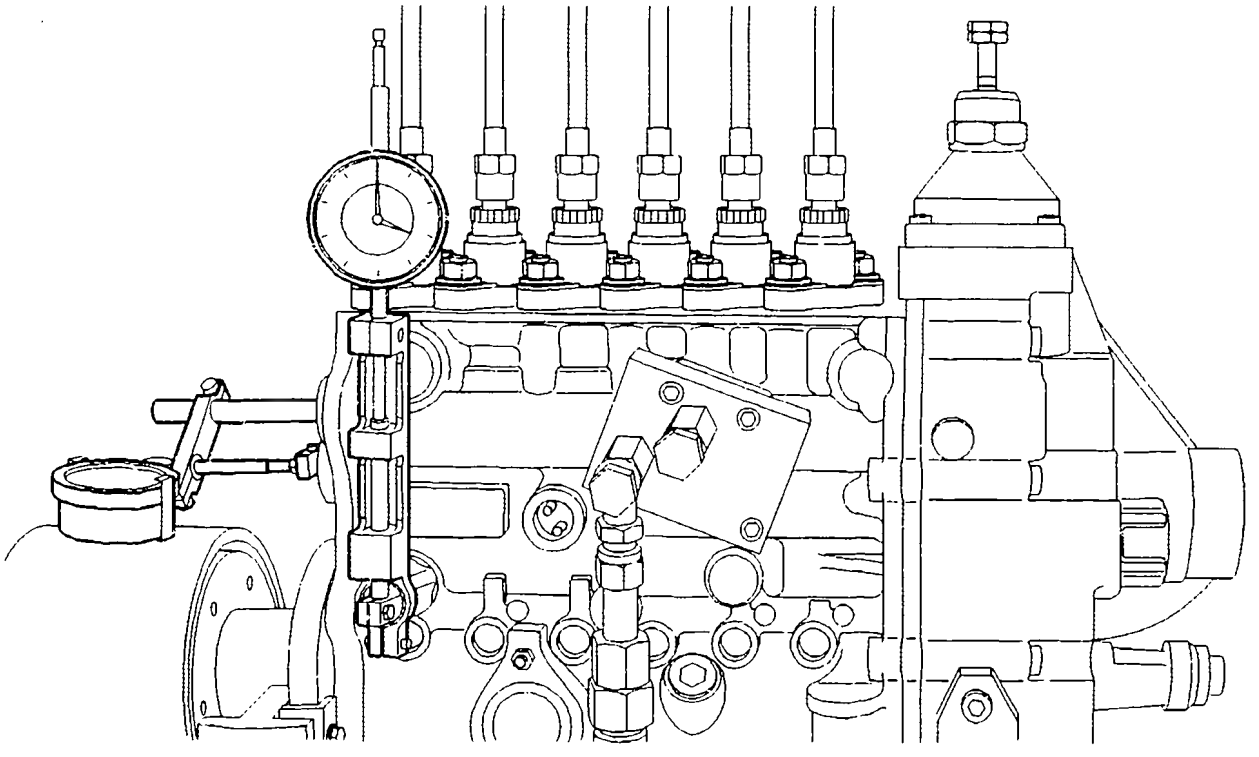
CHECKING INSTRUCTIONS

Testing MAX stop:

* Switch on test bench. Start-of-delivery measurement as per droplet method; see test-specification sheet for inlet pressure.
* Turn camshaft in direction of rotation until start of delivery results (determine precisely) and establish prestroke at start of delivery.
* Set value: "Start of delivery with prestroke MAX" as per test specification sheet +/- 0.05 mm.
* Set pointer of test-bench graduated disk at start of delivery to theoretically most favorable zero value for subsequent testing of angular cam spacing.

Continue: F15/1 Fig.: F14/2

KMK05488



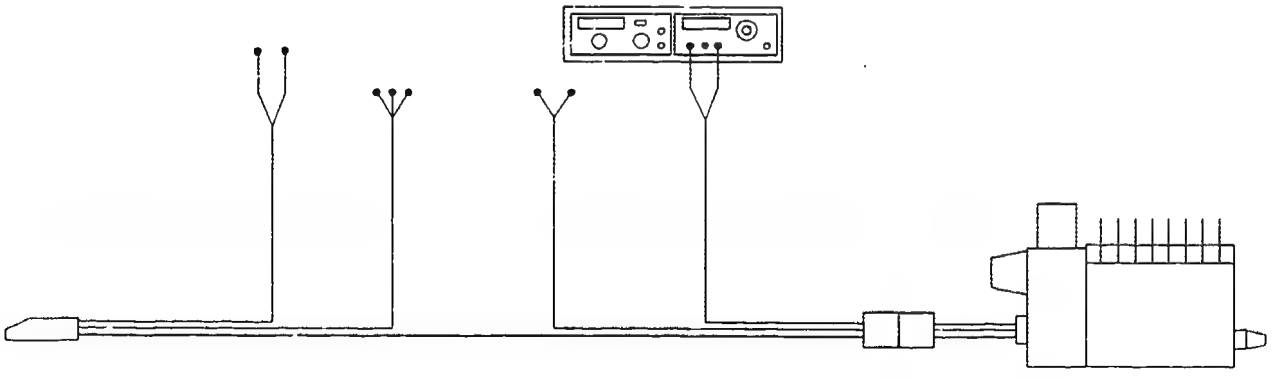
CHECKING INSTRUCTIONS

Testing lower control-lever stop (MIN stop):

* Reset camshaft/roller tappet at start-of-delivery adjustment barrel to BDC.
* Connect actuation line for prestroke solenoid - two-core lead to positioner, plug green (+) and blue (-) - to regulator 12 V/ 15 A.

Continue: F16/1 Fig.: F15/2

KMK05582



CHECKING INSTRUCTIONS

Testing MIN stop:

Note: Terminate following procedure within 1 minute on account of self-heating of prestroke solenoid.

* Set current on regulator to 6...6.5 A - results in full armature deflection.
* Turn camshaft until start of delivery results (determine exactly) and measure prestroke produced.
  Set value: "Start of delivery with prestroke MAX" as test-specification sheet minus 6.2 +/- 0.15 mm.
* Switch off regulator.

Continue: F16/2

CHECKING INSTRUCTIONS

Testing MIN stop:

On completion of measurement remove prestroke measuring device as otherwise it would be destroyed by further turning of camshaft.

Note: If one or both values for the MIN/MAX stops is/are outside tolerance: Fault in prestroke positioner or incorrect setting of stops.

Terminate testing and carry out overall adjustment in line with TEST AND ADJUSTMENT INSTRUCTIONS.

Continue: F17/1

CHECKING INSTRUCTIONS

Testing angular cam spacing:

Note: Angular cam spacing = start of delivery of each barrel. Refer to test-specification sheet for cam sequence and angular spacing in Grad.
Max. tolerance = +/- 0.5 Grad.

Starting point for testing: Zero value of test-bench graduated disk set beforehand at start of delivery of adjustment barrel.

Incorrect result: Terminate test and carry out overall adjustment in line with TEST AND ADJUSTMENT INSTRUCTIONS.

Continue: F18/1

CHECKING INSTRUCTIONS

Delivery testing:

* Connect up test and supply components.
  See Coordinate: D07/1
* Calibrating-oil connection for delivery test.
  See Coordinate: B11/1
* Ensure that with max. CRT the CRT measuring device is set to precisely 21 mm.
* Make sure that camshaft chamber has been filled with lubricating oil.
  See Coordinate: B12/1

Continue: F19/1

CHECKING INSTRUCTIONS

Delivery testing:
Warm up assembly:
Switch on regulator for positioner. Set approx. 10 mm CRT by way of current setting and block with CRT measuring device. Do not switch off regulator. Switch on test bench, set inlet pressure as per test-specification sheet. Pay attention to direction of rotation and warm up assembly at n = 600 1/min. At the same time, warm up calibrating oil to inlet temperature as given in test-specification sheet. Then release control-rod blocking, set 0 A current and shut down fuel-injection pump.

Continue: F19/2

CHECKING INSTRUCTIONS

Delivery testing

* Applies to test points V1 and L1 as per test-specification sheet.
* Set control-rod position for injected quantity values by way of precise adjustment of U/act value as per test specification sheet.
* As regards control-lever pump, additionally pay attention for individual injected-quantity measurement points to certain prestroke positioner settings indicated in test specification sheet as prestroke solenoid travel.
  For attachment of prestroke-solenoid travel measuring device see following Coordinate:

Continue: D22/1

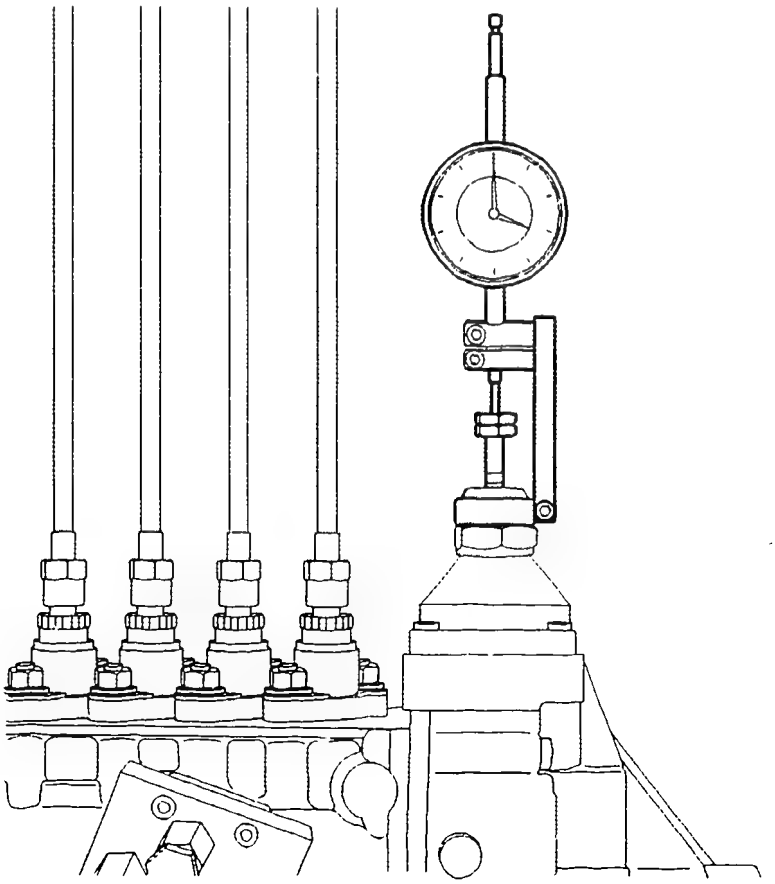
CHECKING INSTRUCTIONS

Delivery testing:

Adjusting travel measuring device for prestroke solenoid:

* Turn back adjusting screw as far as it will go (armature rest position).
* Pretension dial indicator and set to 14 mm (definition value for all positioner versions).
* Data in test-specification sheet regarding solenoid travel are absolute values.
  Example: Indicated stroke 8 mm: Starting from 14 mm, set 8 mm, i.e. position armature 6 mm lower with adjusting screw.

Continue: F21/1 Fig.: F20/2



KMK05502

CHECKING INSTRUCTIONS

Delivery testing:

Test point "V 1" as per test specification sheet (setting point, check value):

* Drive pump at stated speed. By way of current adjustment and fine adjustment by hand precisely set U/act value for V1 and block at CRT measuring device.
* Use adjusting screw to set prestroke solenoid to stated travel value.

Continued on next Coordinate.

Continue: F21/2

TEST AND ADJUSTMENT INSTRUCTIONS

Delivery testing:

* Perform quantity measurement V1. Values must correspond to data given in test-specification sheet.

Note: Determination of the actual deliveries is the same as for all Bosch in-line pumps.
A summary of the relevant criteria is given in the following:

Continue: F22/1

CHECKING INSTRUCTIONS

Delivery testing:

* With graduate-type test benches, the first quantity measurement is designed to moisten the graduates, which are then to be emptied again. Run-out time 30 seconds.
* Determination of delivery with blue line on back of graduate, which forms two points which face one another as a result of refraction on the surface of the liquid.

Continue: F22/2

CHECKING INSTRUCTIONS

Delivery testing:

* The delivery given in the test specifications is the average value for all individual quantities determined.
* The stated scatter designates the maximum permissible difference in quantity between the smallest and largest individual quantity.
* Check values are marked with "P" in the test-specification sheet; values without "P" apply to adjustment.

Continue: F23/1

CHECKING INSTRUCTIONS

Delivery testing:

Test point "L1":
Then perform test point L1.
Procedure for quantity measurement and determination of values as for V1, however note the following:

* Main test criterion for L1 is injected-quantity value as per test-specification sheet. This value must be attained within the stated U/act tolerance range.
  Procedure as described on next Coordinate.

Continue: F23/2

CHECKING INSTRUCTIONS

Delivery testing:

Test point V1:

* Without observing U/act value first set control-rod position such that L1 quantity value as per test-specification sheet is attained, i.e. the correct value may have to be "sought" by measuring several times. The U/act value must now be within the tolerance given in the test-specification sheet.

Continue: F24/1

CHECKING INSTRUCTIONS

Delivery testing:

If the deliveries do not coincide with the prescribed values, injected-quantity correction should not be performed immediately. The cause may be an incorrect quantity setting or a wrongly adjusted RPS.

The RPS setting is thus to be checked first. See following Coordinate.

Continue: F24/2

CHECKING INSTRUCTIONS

Testing RPS adjustment ("Setting" as per test-specification sheet):

* Check whether dial indicator of CRT measuring device is set to precisely 21 mm with maximum CRT.
* By adjusting current, set control rod such that U/act exactly corresponds to value as per test-specification sheet. (Perform fine adjustment by hand at control rod).
* CRT must now likewise correspond to value as per test-specification sheet (check value "P").

Continue: F25/1

CHECKING INSTRUCTIONS

Testing RPS adjustment:

If the RPS adjustment is outside the tolerance, the setting is first to be checked on the basis of the TEST AND ADJUSTMENT INSTRUCTIONS.
See Coordinate: D15/1

The RPS adjustment must be correct before renewed delivery testing can be performed and if necessary adjustment carried out in line with the TEST AND ADJUSTMENT INSTRUCTIONS.
See Coordinate: D21/1

Continue: F25/2

CHECKING INSTRUCTIONS

Further information on delivery and RPS testing:

If the RPS cannot be adjusted or if it is not possible to attain the prescribed deliveries at all measurement points despite correct RPS setting, testing is to be terminated and the assembly repaired/adjusted.

Continue: F26/1

CHECKING INSTRUCTIONS

Functional testing of oil pump (if fitted):

Test prerequisite: Positioner sealed, RPS adjustment hole sealed, control rod in shutoff position (current 0 A).

Test with suitable vacuum gauge (e.g. Bosch vacuum gauge 1 688 130 032 - special accessory for injection-pump test benches - or commercially available) with hose and rubber plug suitable for start-of-delivery bore in adjustment flange.

Continue: F26/2

CHECKING INSTRUCTIONS

Functional testing of oil pump:

Note: Versions with no adjustment flange, but with an oil pump, feature a bore with screw plug in the top side area of the positioner for pouring in oil and as measurement bore for connection of vacuum gauge.

Continue: F27/1

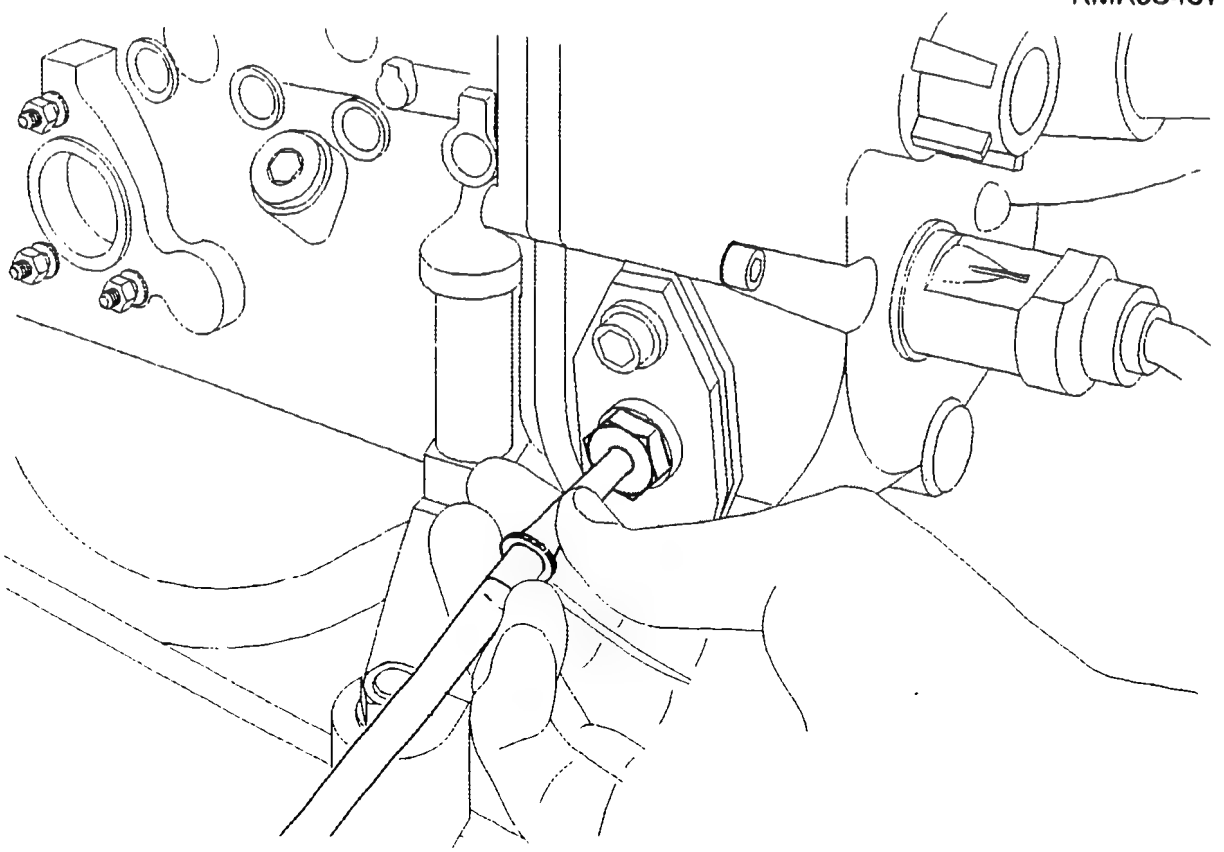
CHECKING INSTRUCTIONS

Functional testing of oil pump:

Screw out screw plug in adjustment flange/top of positioner and pour oil SAE 20 W 20 through tapped hole into positioner as far as overflow/ max. 100 ml.
Run pump at n = 1000 1/min, immediately position rubber plug with hose of vacuum gauge against measurement bore and press on firmly. Establish vacuum value after 30 seconds.
Set value: at least 25 mbar.
Perform repairs if vacuum value is not attained.

Continue: Fig.: F27/2

KMK05491



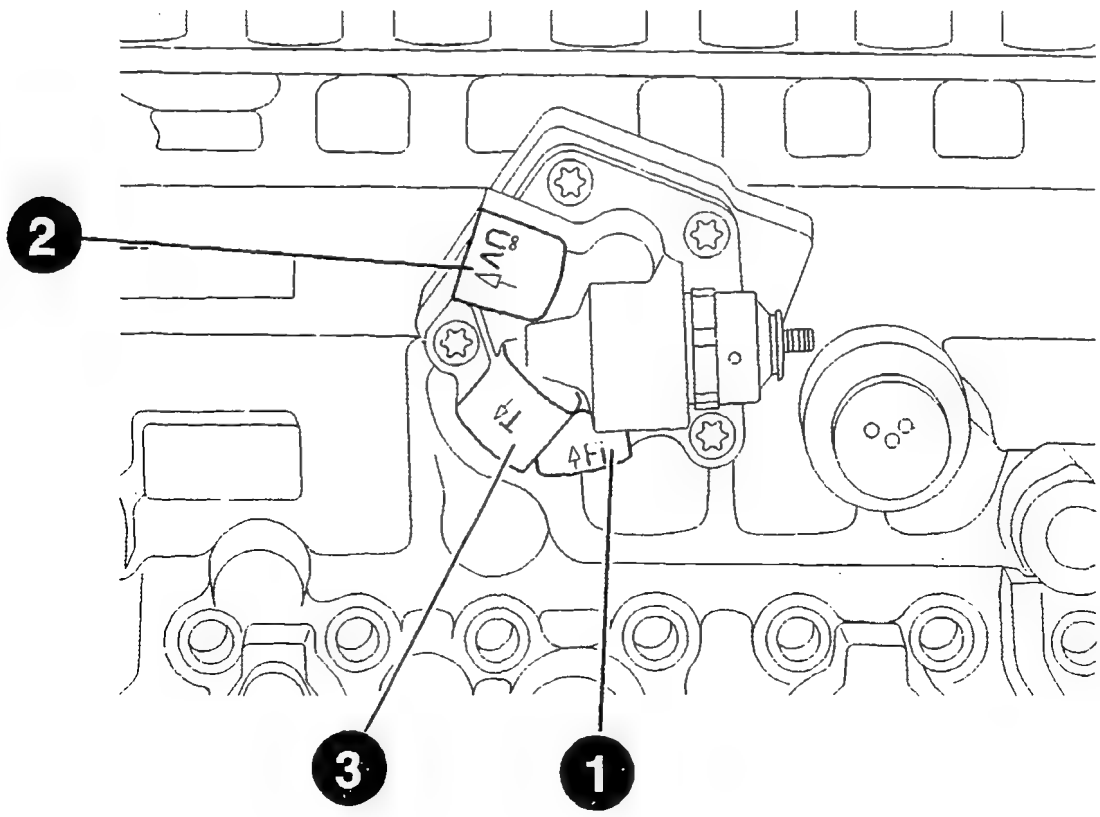
CHECKING INSTRUCTIONS

ELAB functional test (assemblies with ELAB only):

* Unscrew calibrating-oil inlet and return line at adapter.
* Disassemble adapter at pump housing and mount ELAB (complete). Coat fastening screws with Loctite 242 and tighten to 7...9 Nm.
* Calibrating-oil connections (example; connections differ depending on ELAB housing):
  1 = Inlet
  2 = Overflow valve and return
  3 = Sealed

Continue: G01/1 Fig.: F28/2

KMK05586



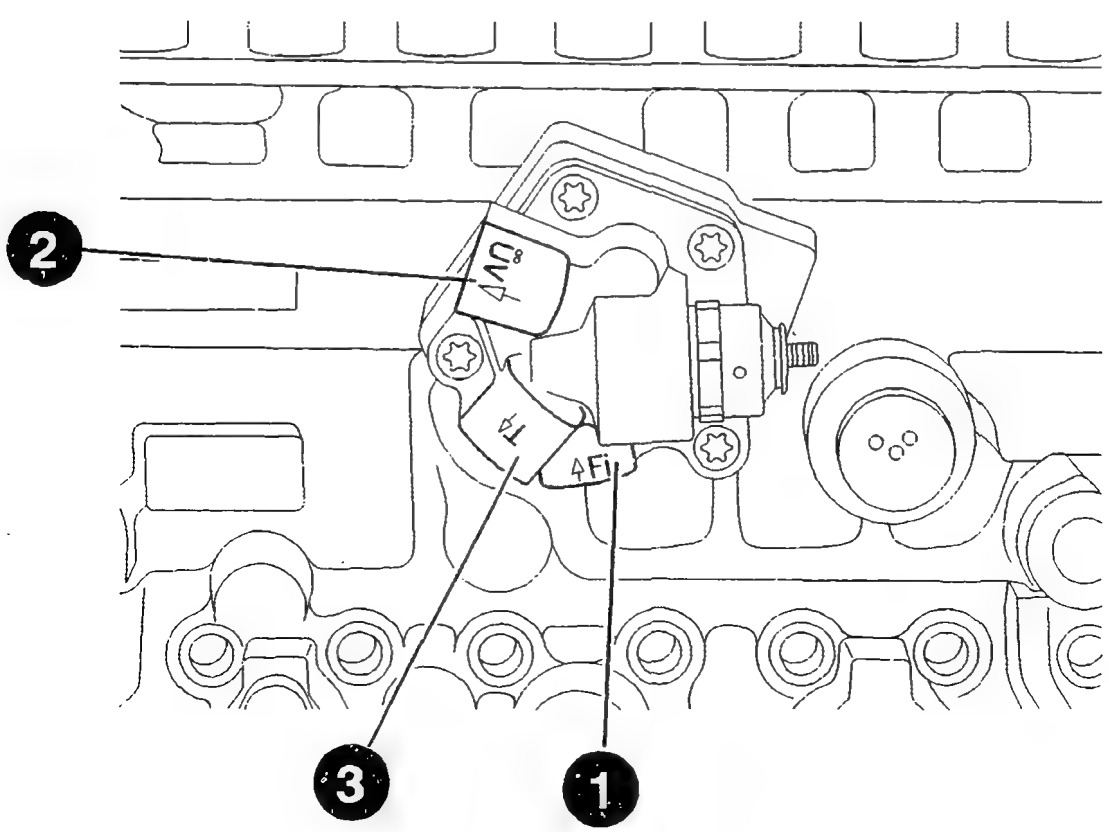
CHECKING INSTRUCTIONS

ELAB functional test:

* Connect power supply to ELAB solenoid valve. Observe correct voltage 12 or 24 V.
* Set speed to: 1000 1/min
* Set control-rod position to U/act: 3.100 V
* After bleeding pump: Disconnect power supply at ELAB solenoid valve and observe quantity delivered at calibrating nozzle holder.
* After a measurement period of 10 seconds delivery at all barrels must be zero.

Continue: G02/1 Fig.: G01/2

KMK05586



CHECKING INSTRUCTIONS

ELAB functional test:

If zero delivery is not obtained after prescribed measurement time: Replace ELAB and repeat functional test.

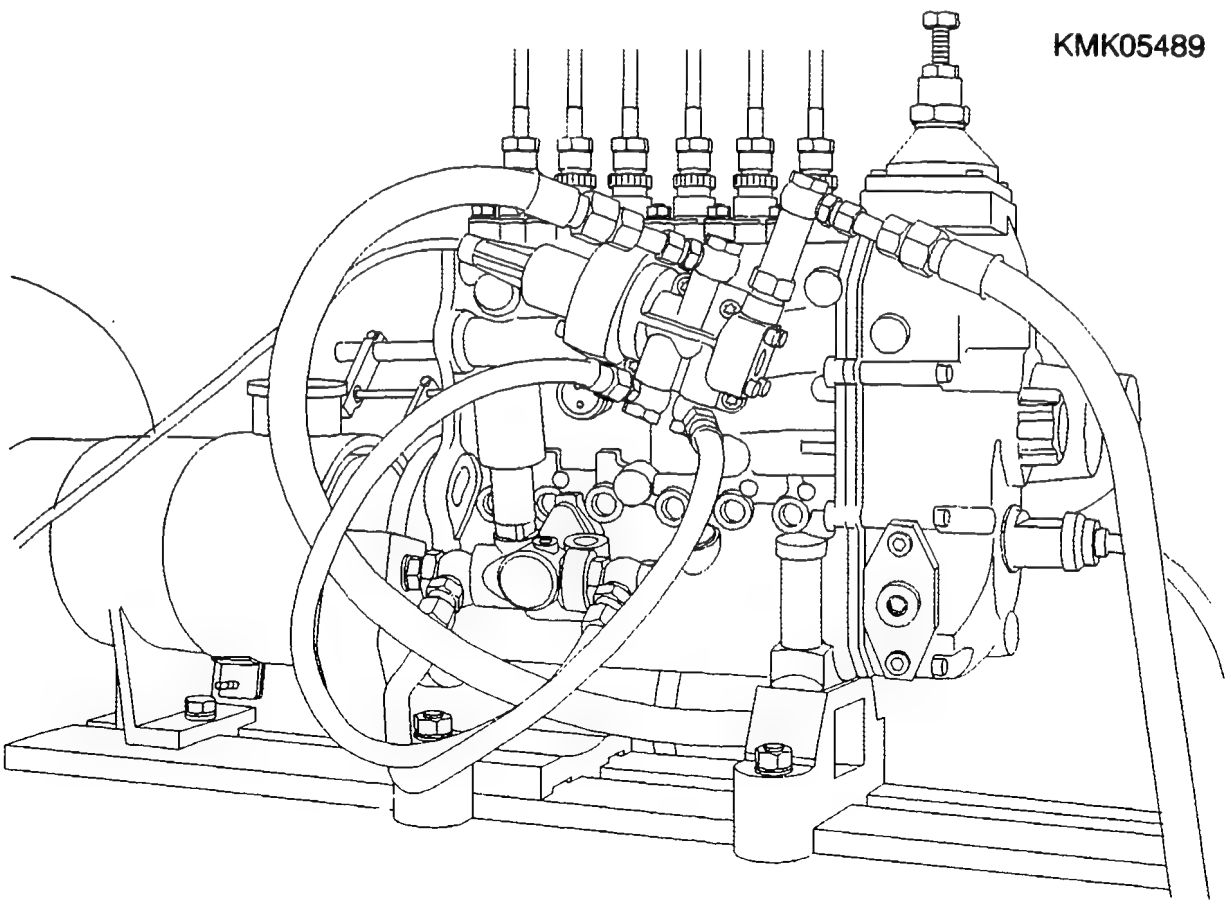
Continue: G03/1

CHECKING INSTRUCTIONS

EHAB functional test (assemblies with EHAB only):

* Unscrew calibrating-oil inlet and return line at adapter.
* Disassemble adapter at pump housing and install EHAB (complete). Coat fastening screws with Loctite 242 and tighten to 7...9 Nm.
* Install fuel supply pump forming part of assembly with new seal and tighten nuts to 7...9 Nm.

Continue: G04/1 Fig.: G03/2



CHECKING INSTRUCTIONS

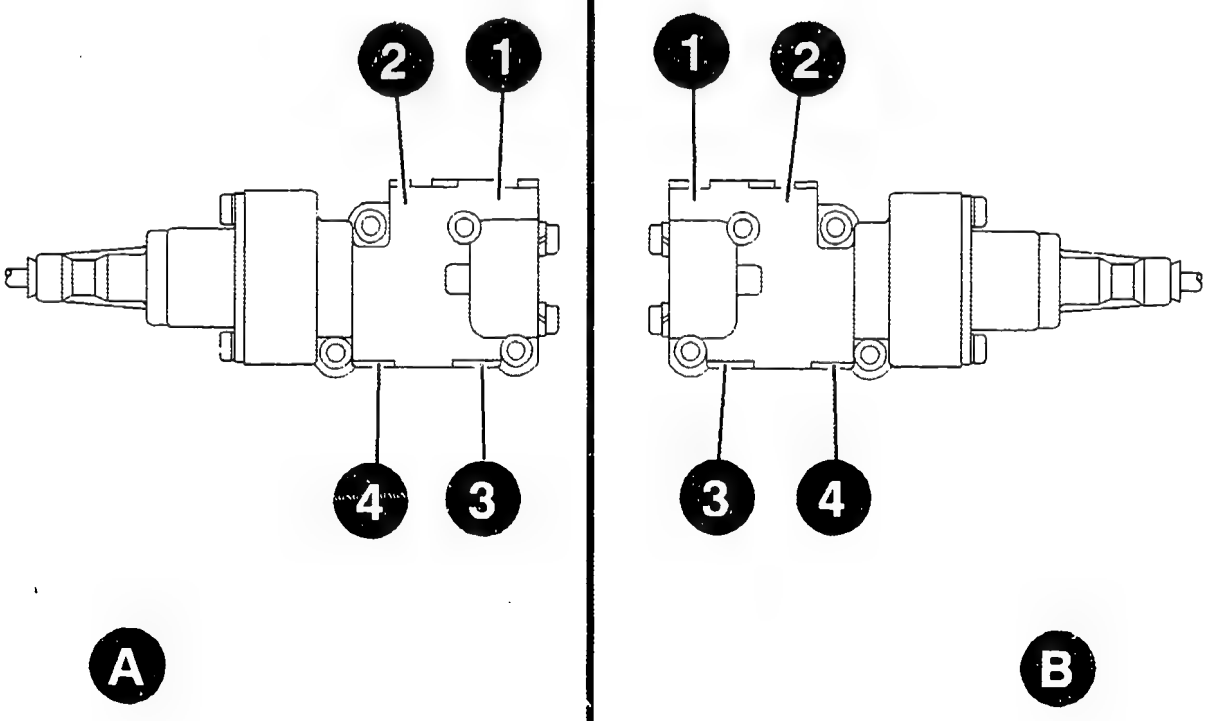
EHAB functional test:

* Calibrating-oil connections: Connections as on engine. Supply pump - EHAB connections with hose set (2 lines) 1 680 711 002.
* Connections to EHAB:
  A = Solenoid, left
  B = Solenoid, right

  1 = Overflow valve and test-bench return
  2 = Test-bench inlet
  3 = To supply pump - intake end
  4 = To supply pump - delivery end

Continue: G05/1 Fig.: G04/2

KMK05587



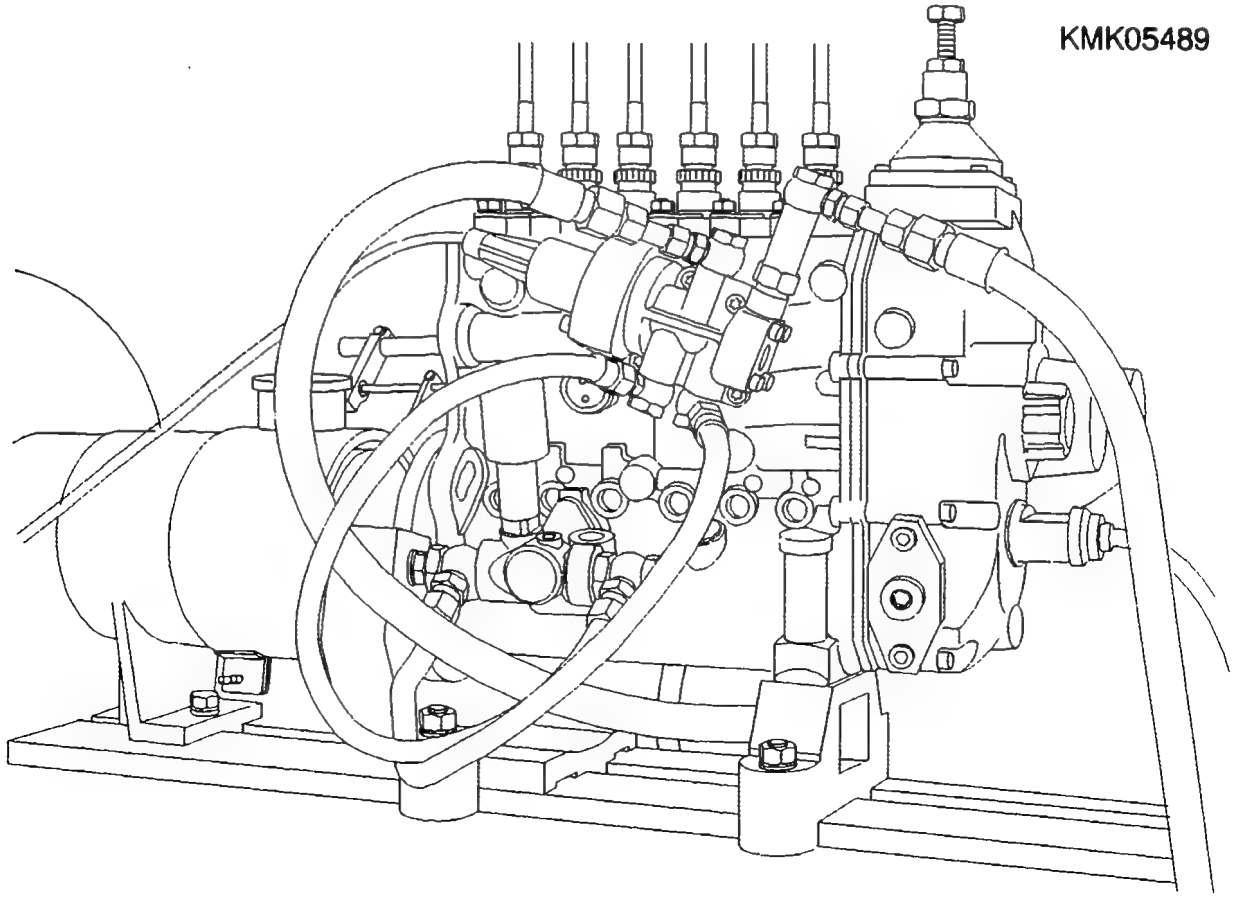
CHECKING INSTRUCTIONS

EHAB functional test:

* Fig.: Complete tubing for EHAB with solenoid attachment, left

1 = Overflow valve with test-bench return
2 = Test-bench inlet
3 = Supply pump - intake end
4 = Supply pump - delivery end

Continue: G06/1 Fig.: G05/2



CHECKING INSTRUCTIONS

EHAB functional test:

Voltage supply, EHAB:

* Voltage supply 12 or 24 V at both pins with individual test leads, e.g. from Bosch test-lead set 1 687 011 208.
  Choice of the correct connections is governed by the plug design.
  Voltage supply via appropriate test-bench jacks.

Continue: G07/1

CHECKING INSTRUCTIONS

EHAB functional test:
Test procedure:
* Connect power supply to EHAB solenoid. Observe correct voltage 12 or 24 V.
* Switch on test bench.
  Set inlet pressure to: 0 bar
* Set speed to: 1000 l/min
* Set control-rod position to U/act: 2.500 V
* Set prestroke solenoid travel to: 14 mm (rest position)

Continued on next Coordinate:

Continue: G07/2

CHECKING INSTRUCTIONS

EHAB functional test:

Test procedure (continued):
* After bleeding pump:
  Disconnect power supply at EHAB solenoid and observe quantity delivered to calibrating nozzle holder.
* After a measurement time of 1 second delivery at all barrels must be zero.

Repair or replace EHAB if zero delivery is not attained within prescribed period.

Continue:

CHECKING INSTRUCTIONS

Delivery:

If testing does not reveal any faults/ repairs are not necessary, remove assembly from test bench and assemble for delivery:

* If necessary, drain any surplus lubricating oil out of camshaft chamber.
* If necessary, insert plastic seal with new seal ring in RPS adjustment bore.
* Screw control-rod closure cap to pump drive end.

Continue: G08/2

CHECKING INSTRUCTIONS

Delivery:

* Fit/complete original drive coupling.
* On assemblies with oil pump, pour in oil SAE 20 W 20 via hole in adjustment flange/top of positioner housing as far as overflow/max. 100 ml.

Continue: G09/1

CHECKING INSTRUCTIONS

Delivery:

* Wipe calibrating oil off assembly and apply paint seals:
  - One barrel-and-valve assembly fastening nut each
  - Control-rod screw plug
  - ELAB/EHAB fastening screw
  - Positioner fastening screw on versions with no plastic seal
  - Cap and lock nut, control-rod guide
  - Fastening screw, drive-end bearing
  - Housing cover, prestroke solenoid

Continue: N27/1

SPECIAL VERSIONS

Table of contents:

Continue: H01/2

SPECIAL VERSIONS

General:

The following section describes manufacturer-specific special features for control-lever pumps and the resultant special procedure with regard to testing and adjustment.

These instructions make allowance for the special versions known at the time of compilation.

Continue: H02/1

SPECIAL VERSIONS

General (continued):

Testing and adjustment of all control-lever pumps as well as installation and driving on test bench are performed as described in the "Test and adjustment instructions" using the clamping and driving elements listed in the section "Testers, fixtures and tools".

The following deals with the additional operations required in the case of manufacturer-specific special features.

Continue: H02/2

SPECIAL VERSIONS

General (c r

Note: The delivery mark/ blocking ne drive flange as described in this section affects pumps of the engine manufacturers Mercedes Benz and Scania (refer to table of contents).

With MAN pumps there is no mark at the drive flange, but rather blocking at the start-of-delivery cam in the positioner as described in the "Test and adjustment instructions".

Continue: H01/1

SPECIAL VERSIONS

Disassembly and assembly of drive flange:

Tightening torques for drive-flange securing nut with the various versions (compliance is essential):

* MAN RP 39 (M30 x 1.5): 400...440 Nm
* MAN RP 43 (M24 x 1.5): 340...370 Nm
* Mercedes Benz RP 43 (M 24 x 1.5): 340...370 Nm
* Scania RP 39 (M 30 x 1.5): 470...510 Nm

Continue: H04/1

SPECIAL VERSIONS

Disassembly and assembly of drive flange:

The tightening and release torques for the drive-flange securing nuts are extremely high (up to 510 Nm). For loosening and tightening the nut and for removing the flange, the pump is to be assembled for safety reasons on the clamping rail of the test bench and secured such that there is sufficient space for working between the flange and test-bench coupling.

Continue: H04/2

SPECIAL VERSIONS

Disassembly and assembly of drive flange:

Pumps with end-flange mounting and manufacturer-specific housing intermediate flange (Mercedes Benz and MAN) require use of the clamping flange 1 685 720 210 and 4 spacers, diameter 10 mm, approx. 5 mm thick for clamping.

Use is to be made of the universal holding device 0 986 612 694 for counterholding at the drive flange and for pressing off taper of camshaft.

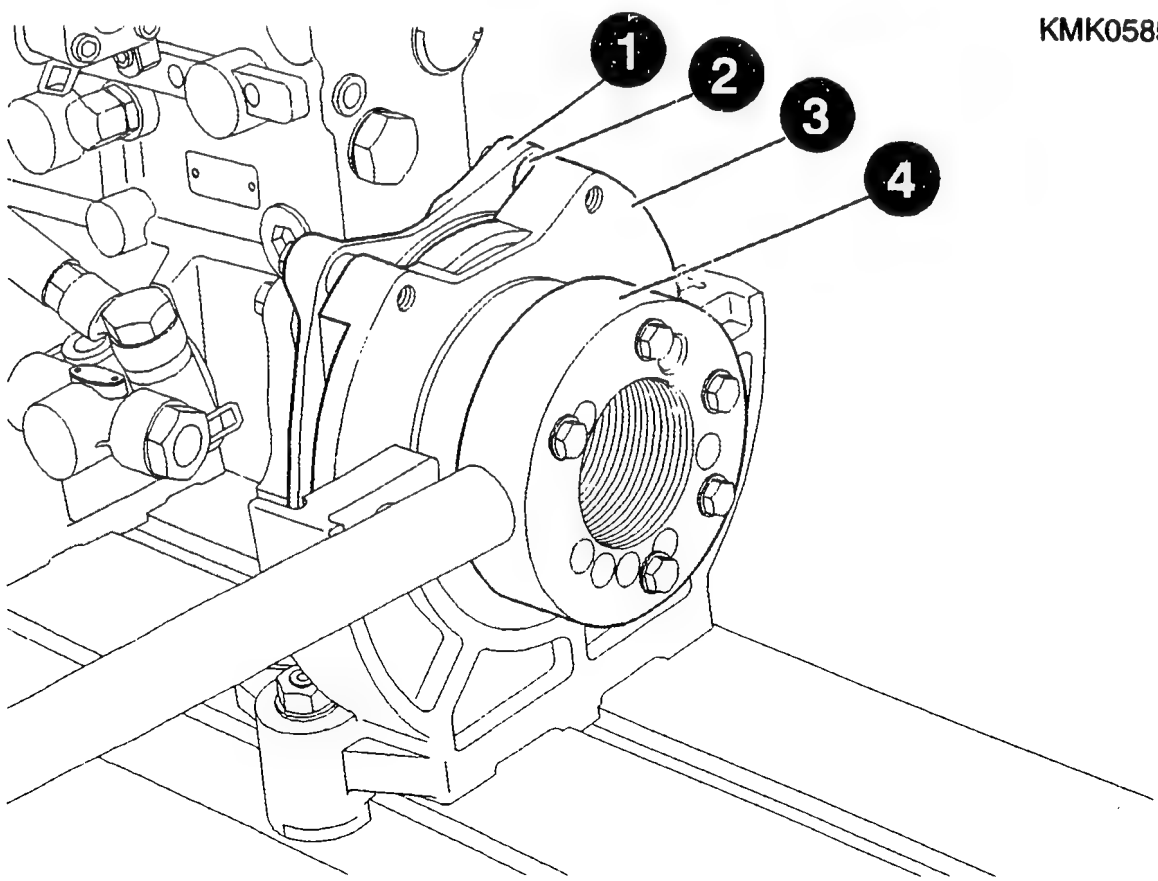
Continue: H05/1

SPECIAL VERSIONS

Disassembly and assembly of drive flange:

Clamp pumps with end-flange mounting and housing intermediate flange as shown. Insert spacers between housing intermediate flange and clamping flange.
Use all screws to screw holding device to drive flange (pilot in direction of drive flange).
1 = Housing intermediate flange
2 = Spacers 10mm, approx. 5mm thick
3 = Clamping flange 1 685 720 210
4 = Holding device 0 986 612 694

Continue: H06/1 Fig.: H05/2



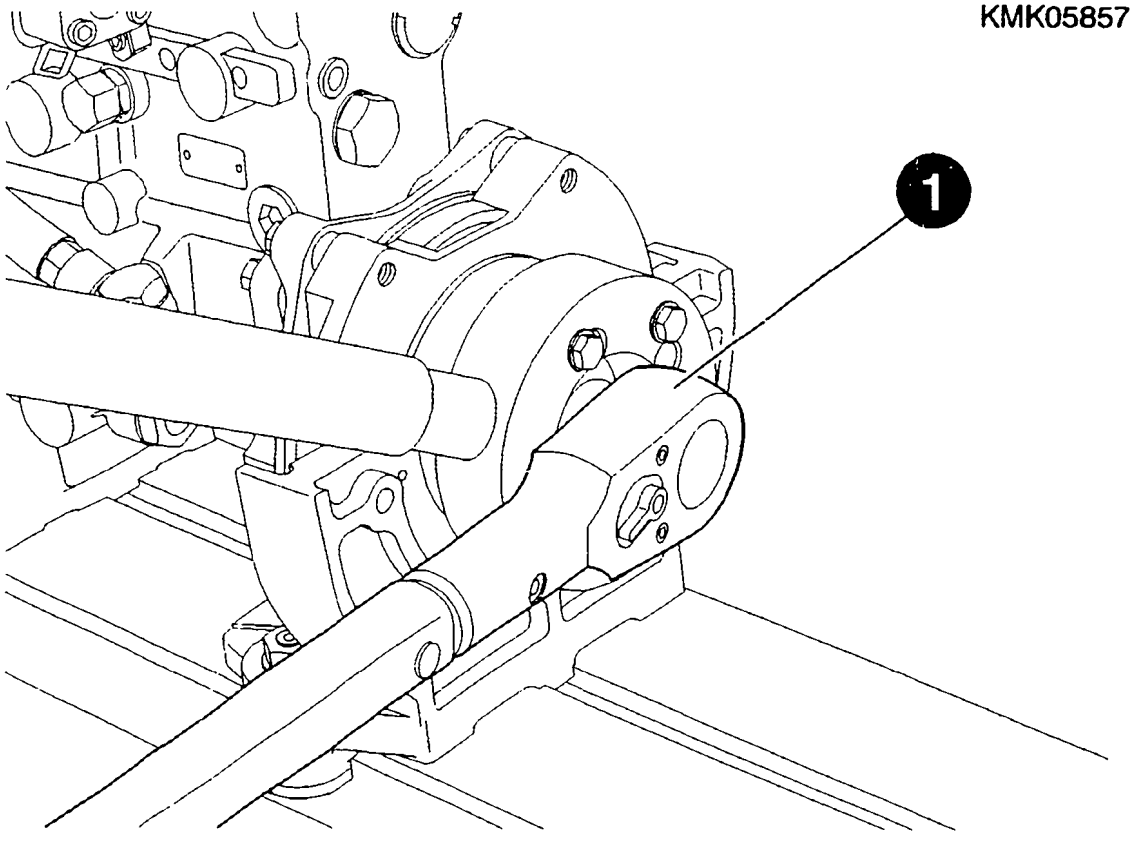
SPECIAL VERSIONS

Disassembly and assembly of drive flange:
To loosen/tighten drive-flange securing nut, counterhold with holding device using extension if necessary.
Important: Screw rod into holding device as far as it will go. Never support device on test-bench clamping rail for counterholding.
The high loosening/tightening torque must not be transmitted to clamping bracket, pump flange and clamping rail.

1 = Torque wrench

Continue: H07/1 Fig.: H06/2

KMK05857



SPECIAL VERSIONS

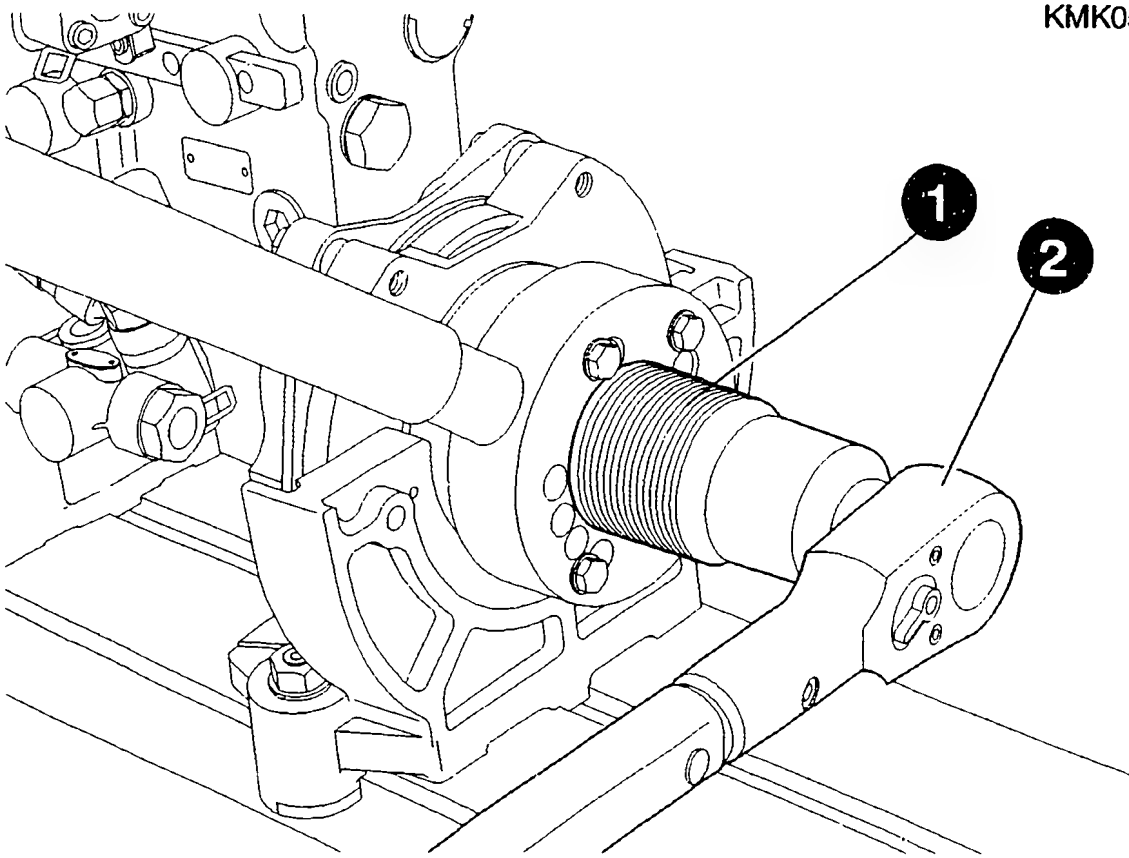
Disassembly and assembly of drive flange:

Screw extractor into holding device and press drive flange off taper of camshaft.
Important: Here again holding device is not to be supported on clamping rail. Only loosen drive flange. It has a larger diameter than the clamping flange.

1 = Extractor
2 = Wrench

Continue: H08/1 Fig.: H07/2

KMK05858



SPECIAL VERSIONS

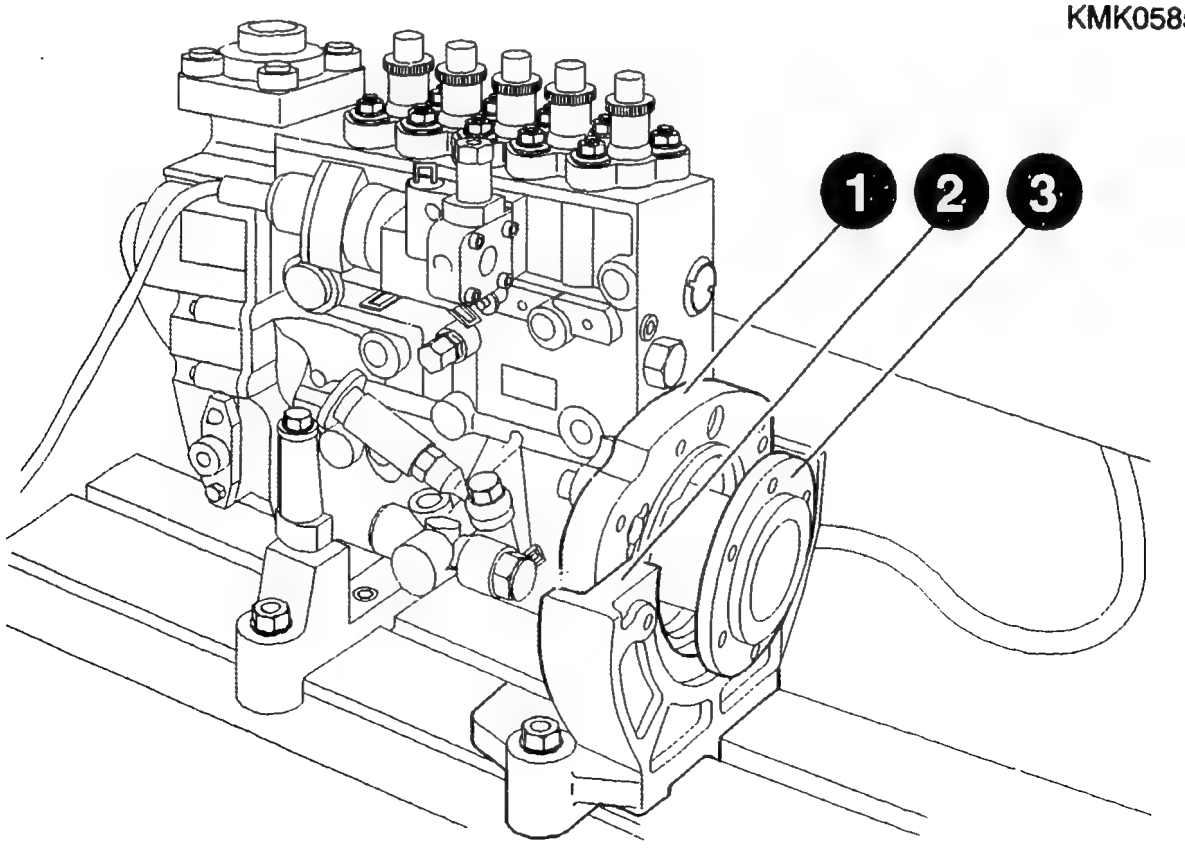
Disassembly and assembly of drive flange:

Remove pump. Housing intermediate flange and drive flange can now be detached and the pump mounted on the test bench using the normal clamping elements.

1 = Clamping flange corresponding to pilot diameter
2 = Universal clamping bracket
3 = Coupling flange in line with taper, for adaption with test-bench drive coupling 1 686 401 024

Continue: H09/1 Fig.: H08/2

KMK05859

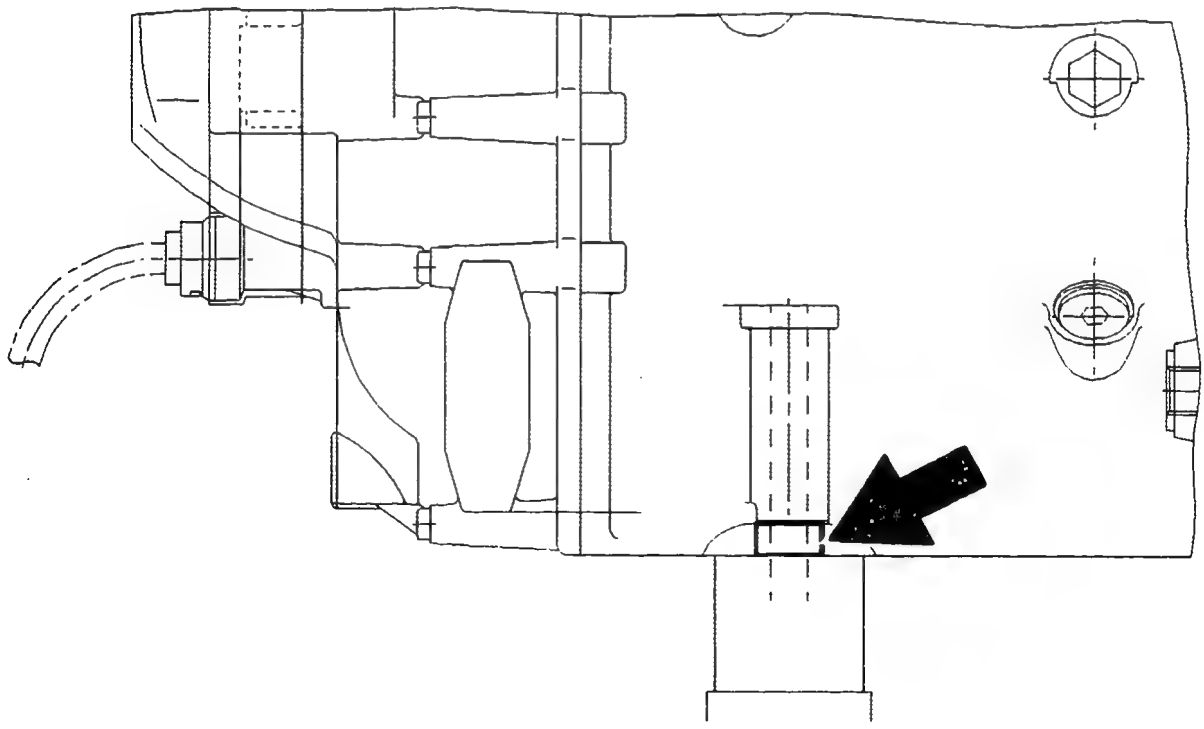


SPECIAL VERSIONS

Disassembly and assembly of drive flange:
Pumps with end-flange mounting without housing intermediate flange (Scania) and with cradle mounting (Mercedes Benz) can be installed on the test bench for the assembly work described above using the normal series clamping elements listed under "Testers, fixtures and tools".
Note: With Scania pumps, spacer sleeves (contained in parts set EPS 917) are to be used (fig., arrow) for attachment to support frame.

Continue: H01/1 Fig.: H09/2

KMK05863



SPECIAL VERSIONS

Start-of-delivery mark on drive flange (Mercedes Benz, pump with cradle mounting):

After testing/adjustment detach injection pump from test-bench drive. Unscrew delivery lines at calibrating-nozzle holder and slide pump back on clamping rail to leave sufficient space for working on pump drive. Reconnect delivery lines to calibrating-nozzle holder.

Detach test coupling flange at taper of camshaft.

Continue: H10/2

SPECIAL VERSIONS

Start-of-delivery mark on drive flange (Mercedes Benz, pump with cradle mounting):

Grind off previous start-of-delivery mark on periphery of original drive flange and mount flange (angle arbitrary, no wedge at taper).
Mount holding device 0 986 612 694 at flange, tighten securing nut to 340...370 Nm.
Important: Counterhold with holding device. Never support device on test-bench clamping rail.

Continue: H11/1

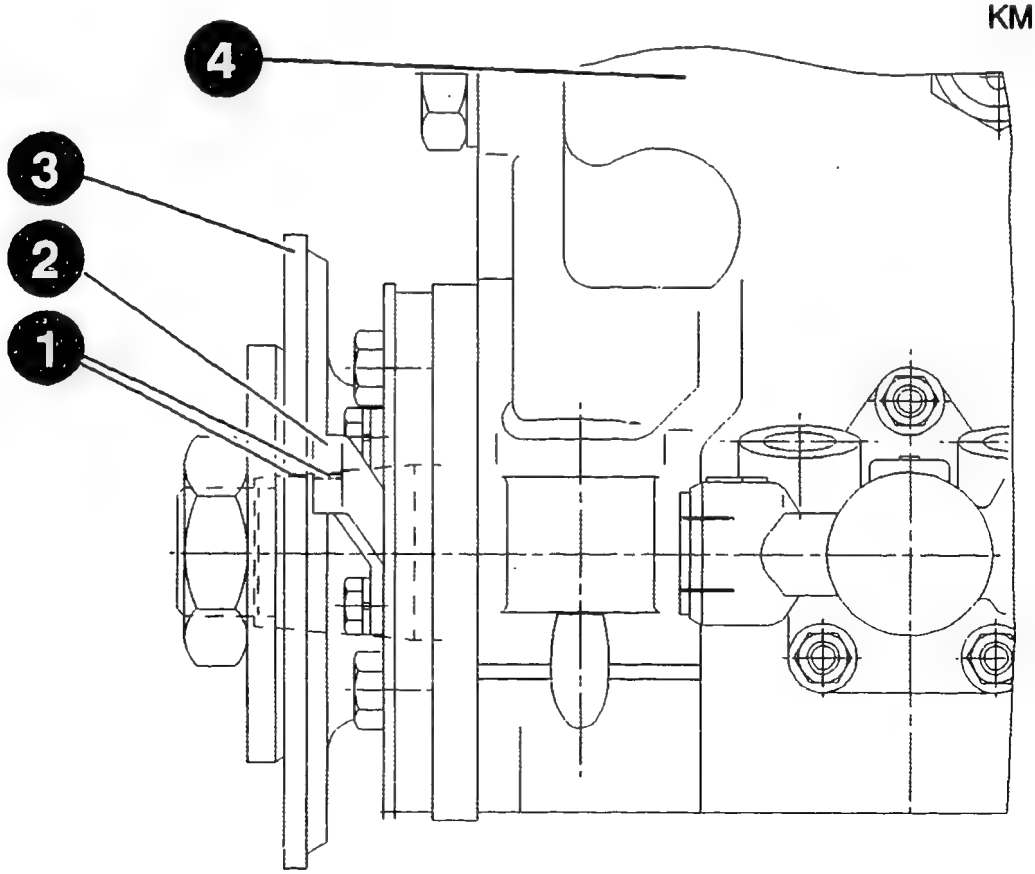
SPECIAL VERSIONS

Start-of-delivery mark on drive flange (Mercedes Benz, pump with cradle mounting):

Set pump precisely to actual start-of-delivery at adjustment barrel (drip method); to do so, turn camshaft with holding device.
In this position, precisely transfer start-of-delivery mark from fixed indicator plate to drive flange.
1 = Start-of-delivery notch
2 = Start-of-delivery indicator
3 = Drive flange
4 = Injection pump

Continue: H01/1 Fig.: H11/2

KMK05862



SPECIAL VERSIONS

Start-of-delivery mark on drive flange (Mercedes Benz, pump with end-flange mounting):

After testing/adjustment remove pump from test bench. Disassemble test coupling flange and clamping flange.

Mount original housing intermediate flange at pump flange.
Position original drive flange at taper of camshaft. Tighten nut such that camshaft can still be turned.

Continue: H12/2

Start-of-delivery mark on drive flange (Mercedes Benz, pump with end-flange mounting):

Reinstall pump on test bench as described in section "Disassembly and assembly of drive flange".
See Coordinate: H03/1
Install pump such that there is sufficient space for working at drive.

Connect up calibrating-oil supply and delivery lines.
Screw holding device 0 986 612 694 to drive flange.

Continue: H13/1

SPECIAL VERSIONS

Start-of-delivery mark on drive flange (Mercedes Benz, pump with end-flange mounting):

Set pump exactly to actual start-of-delivery at adjustment barrel (drip method); to do so, turn camshaft with holding device.

In this position, loosen securing nut and drive flange so that flange can be turned (if necessary, release flange from taper of camshaft using pressure spindle of holding device).

Continue: H14/1

SPECIAL VERSIONS

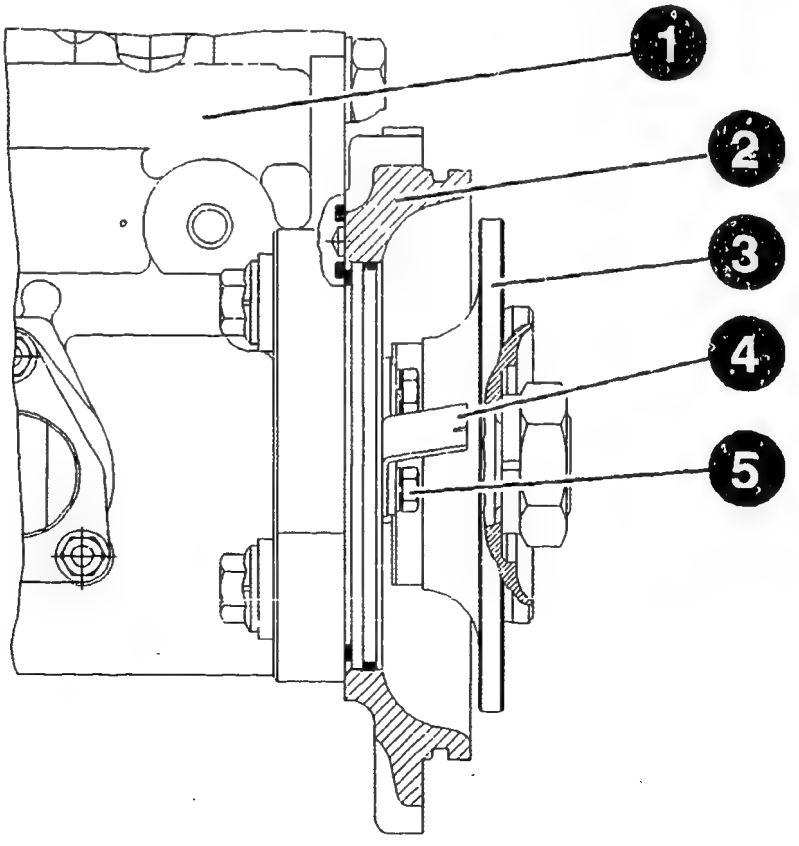
Start-of-delivery mark on drive flange (Mercedes Benz, pump with end-flange mounting):

Remove sight-hole plate in housing intermediate flange (not visible in illustration, as sectional view of intermediate flange) so that notch in indicator is visible.

1 = Injection pump
2 = Housing intermediate flange (sectional view)
3 = Drive flange
4 = Start-of-delivery indicator with notch
5 = Fastening screws for indicator

Continue: H15/1 Fig.: H14/2

KMK05861

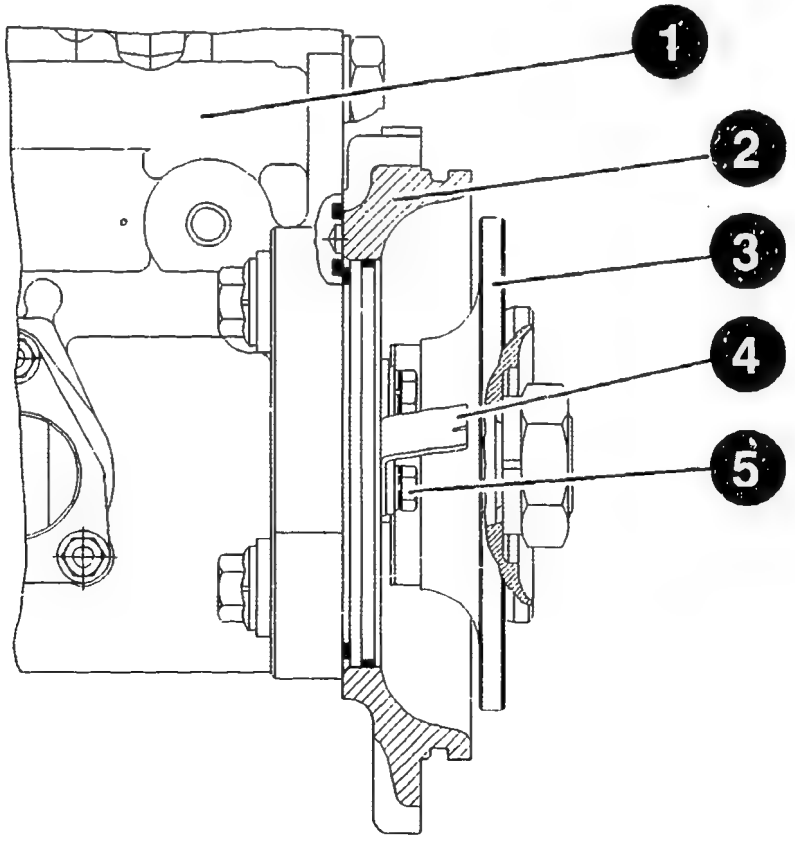


SPECIAL VERSIONS

Start-of-delivery mark on drive flange (Mercedes Benz, pump with end-flange mounting):
In exact start-of-delivery position, turn drive flange such that notches of indicator and flange (white field on back of flange) precisely coincide.
Tighten flange securing nut to 340...370 Nm.
Important: Counterhold with holding device. Never support device on test-bench clamping rail.
Repeat measurement as a check.

Continue: H16/1 Fig.: H15/2

KMK05861



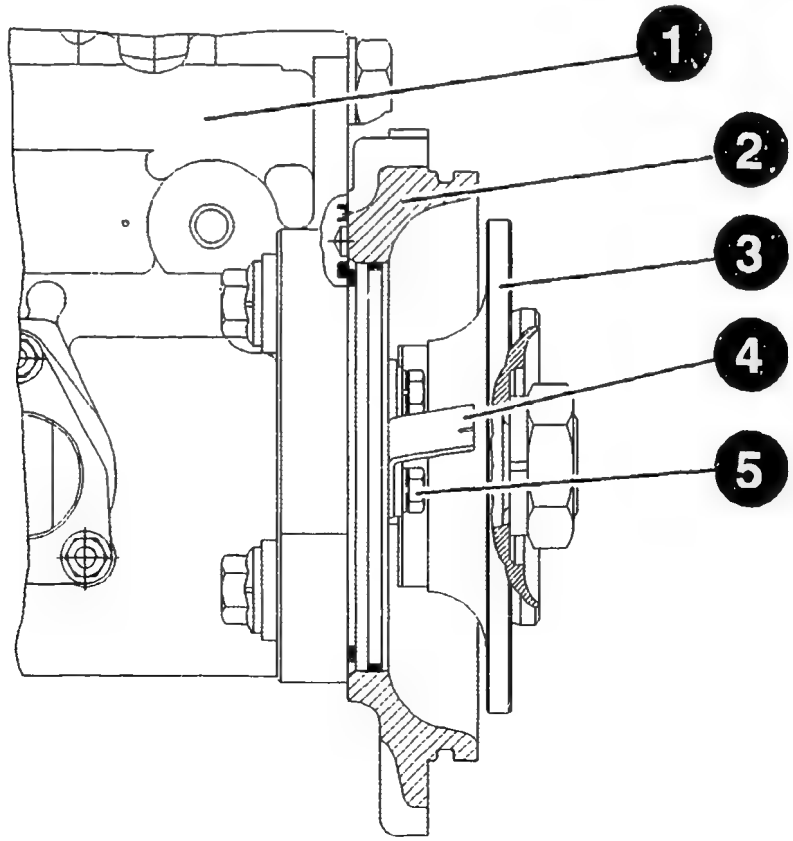
SPECIAL VERSIONS

Start-of-delivery mark on drive flange (Mercedes Benz, pump with end-flange mounting):

Fine correction can be made by moving the indicator (4). To do so, remove clamping bracket and clamping flange and place second support frame beneath pump. Loosen indicator fastening screws (5) (offset wrench 10 mm) and move indicator in area of slots such that marks exactly coincide.

Continue: H01/1 Fig.: H16/1

KMK05861



SPECIAL VERSIONS

Start-of-delivery blocking on drive flange (Scania):

After testing/adjustment, detach injection pump from test-bench drive. Unscrew delivery lines at calibrating-nozzle holder and slide back pump on clamping rail such that sufficient space remains for working on pump drive. Reconnect delivery lines to calibrating-nozzle holder.

Remove test coupling flange at taper of camshaft.

Continue: H18/1

SPECIAL VERSIONS

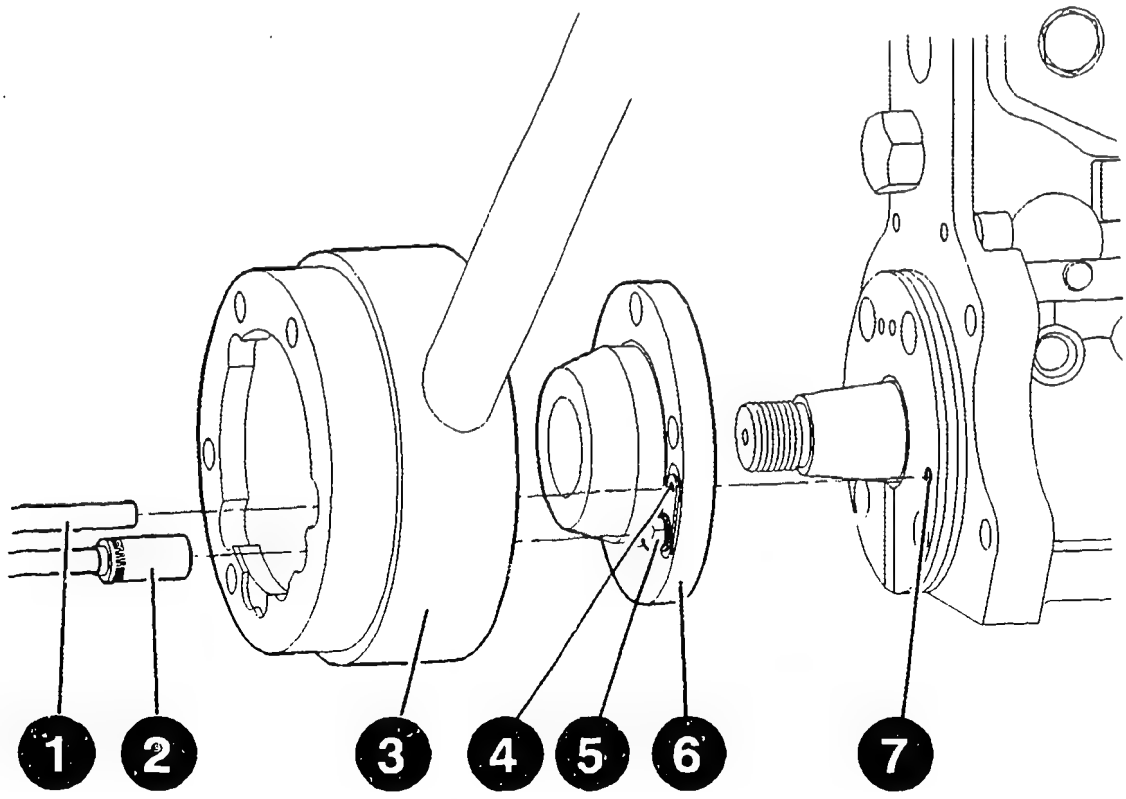
Start-of-delivery blocking on drive flange (Scania):

The following illustration shows drive flange and tools in non-assembled condition for greater clarity.

1 = Setting pin 0 986 612 697
2 = Socket wrench 10 mm
3 = Holding device 0 986 612 694
4 = Adjustment slide in drive flange with setting hole
5 = Fastening screw for adjustment flange
6 = Drive flange
7 = Positioning hole in bearing flange

Continue: H19/1 Fig.: H18/2

KMK05860



SPECIAL VERSIONS

Start-of-delivery blocking on drive flange (Scania):

Attach original Scania drive flange with wedge to taper of camshaft. Screw on securing nut.

Loosen fastening screw for adjustment slide in drive flange.

Use all screws to attach holding device 0 986 612 694 to drive flange (note correct position of recess with respect to adjustment slide in flange).

Continue: H19/2

SPECIAL VERSIONS

Start-of-delivery blocking on drive flange (Scania):

Tighten securing nut for drive flange to 470...510 Nm.

Important: Counterhold with holding device. Use extension if necessary. Never support device on test-bench clamping rail.

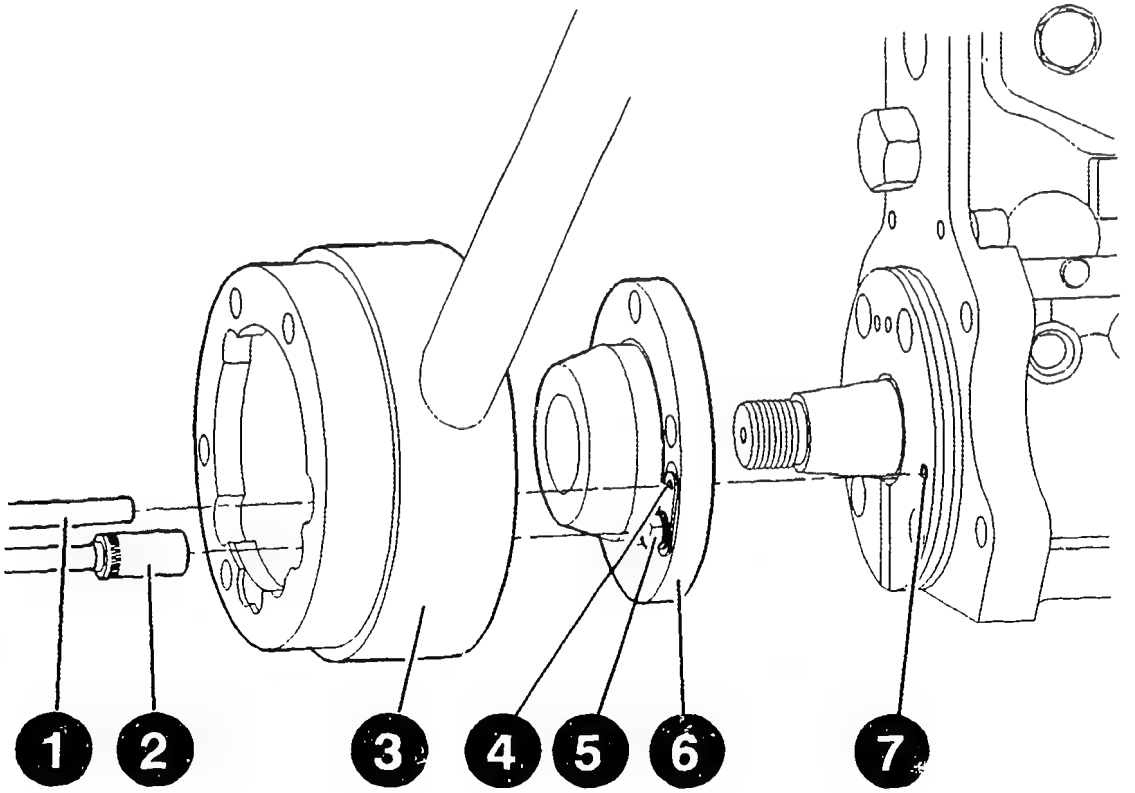
Continue: H20/1

SPECIAL VERSIONS

Start-of-delivery blocking on drive flange (Scania):
Set pump exactly to actual start-of-delivery (drip method) at adjustment barrel; to do so, turn camshaft with holding device.
In this position, insert setting pin 0 986 612 697 (1) through corresponding hole in holding device (3) and through positioning hole in adjustment slide (4). In doing so, set adjustment slide such that setting pin can be inserted into positioning hole in pump bearing flange (7).

Continue: H21/1 Fig.: H20/2

KMK05860



SPECIAL VERSIONS

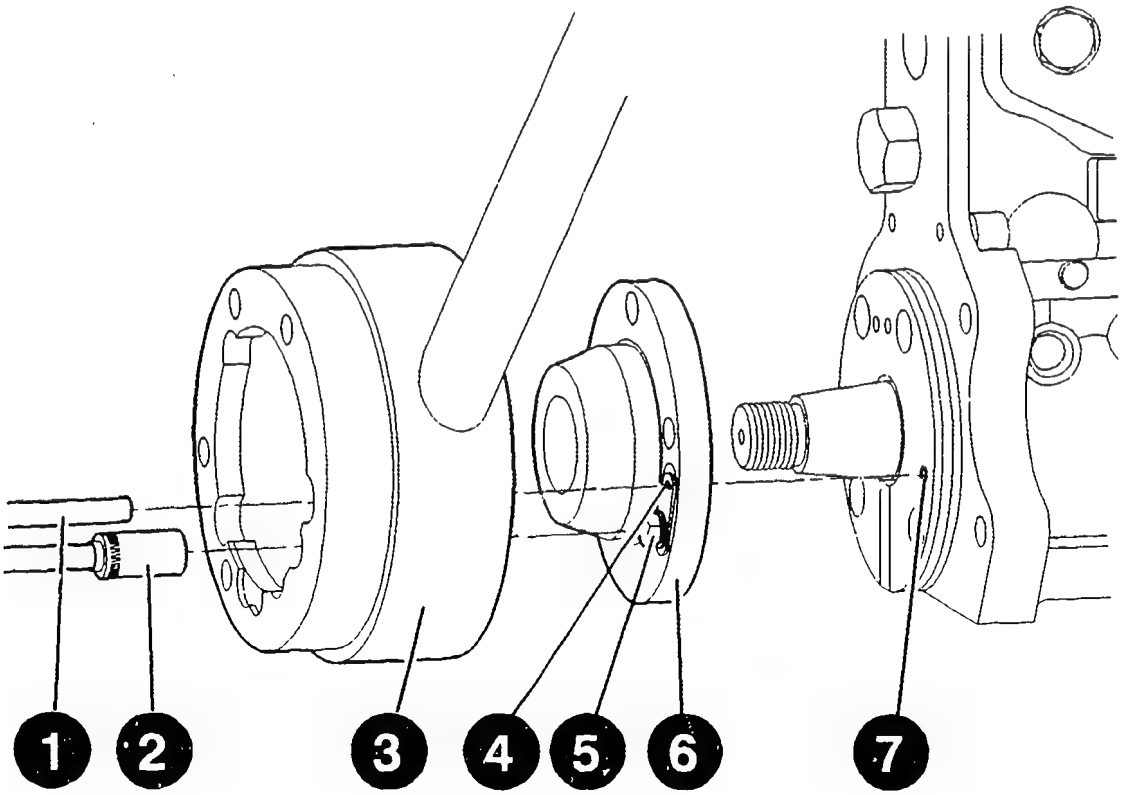
Start-of-delivery blocking on drive flange (Scania):

With positioning pin (1) fitted, insert socket wrench (2) through appropriate hole in holding device (3) and tighten fastening screw of adjustment slide (4) to 7...9 Nm.

Remove positioning pin and holding device.

Continue: H22/1 Fig.: H21/2

KMK05860



SPECIAL VERSIONS

Initial testing, start-of-delivery mark/blocking:

Should it prove necessary within the scope of warranty/initial testing to check the start-of-delivery mark/ start-of-delivery blocking, this must be done prior to disassembly of the drive flange, i.e. before actual pump testing.
In this case, proceed exactly as described in this section for new start-of-delivery mark/blocking.
Refer to following Coordinate information.

Continue: H22/2

SPECIAL VERSIONS

Initial testing, start-of-delivery mark/blocking:

* Mercedes Benz, pump with cradle mounting
  see Coordinate H10/1

* Mercedes Benz, pump with end-flange mounting
  see Coordinate H12/1

* Scania,
  see Coordinate H16/1

Continue: N27/1

INDEX

Continue: N24/2

INDEX

Continue: N25/1

INDEX

Continue: N25/2

INDEX

Continue: N26/1

INDEX

Continue: N26/2

INDEX

Continue: N27/1

TABLE OF CONTENTS

Continue: A01/1

EDITORIAL NOTE

Automotive-Equipment After-Sales Service
Technical Publications Department KH/VDT,
Postfach 30 02 20, D-70422 Stuttgart

Published by:
After-Sales Service Department for Training and
Technology (KH/VSK).
Time of going to press 02.1995.
Please direct questions and comments concerning the contents to our authorized representative in your country.

Continue: N28/2

EDITORIAL NOTE

The contents of this microcard are intended only for the Bosch Franchised After-Sales Organization. Passing on to third parties is not permitted.

Microfilmed in the Federal Republic of Germany.

Microphotographié en République Fédérale d'Allemagne.

Continue: A01/1